OPERATION AND SERVICE MANUAL

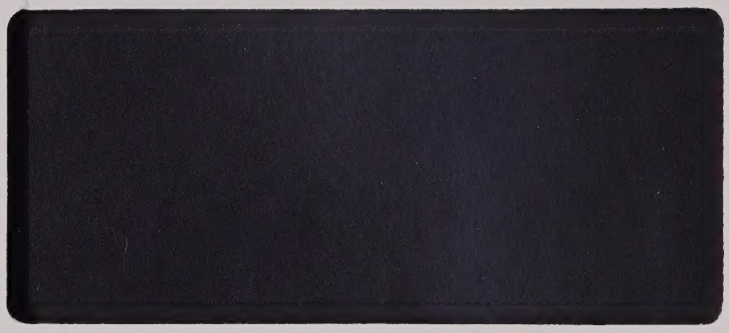
for

Model 430A

SWEEP OSCILLATOR

WEINSCHEL ENGINEERING

GAITHERSBURG, MARYLAND



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SWEEP OSCILLATOR

January 1973

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Weinschel Engineering
Gaithersburg, Maryland
1973

IM95-1/73

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ADDENDUM
FOR
MODEL 430A
SWEEP OSCILLATOR
OPERATION AND SERVICE MANUAL

Make changes to this manual in accordance with Errata listed below.

Errata

Page 5-17, Table 5-3

Add:	TB2, B139-145, Block, Terminal
Change:	Extender, Board Part No. to B139-240

Page 5-18, Table 5-4

Add:	A1, Part No. C139-128, Marker & Waveform Generator
Add:	A1C24, Part No. 31-78, Cap, tant, 1 μf, 20%, 35V
Add:	A1C25, Part No. 34-21-22, Cap, ceramic, 22 pf, 10%, 200V

Page 5-19, Table 5-4

A1Q15:	Change to 2N4403
A1Q17:	Change to 2N4401

Page 5-20, Table 5-4

A1R27:	Change resistor type to film
A1R46:	Change wattage to 0.3W
A1R48:	Change wattage to 0.3W
A1R49:	Change wattage to 0.3W
A1R52:	Change wattage to 0.3W

Page 5-21, Table 5-4

A1R58:	Change wattage to 0.3W
A1R59:	Change wattage to 0.3W
A1R63:	Change wattage to 0.3W
A1R75:	Change wattage to 0.3W
A1R76:	Change wattage to 0.3W
A1R77:	Delete Part No. and Description and add Not Used
A1R90:	Change wattage to 0.3W
A1R91:	Change wattage to 0.3W

Page 5-22, Table 5-4

A1R109:	Change value to 1.5K
A1R112:	Change value to 100 ohm
A1R113:	Change Part No. to 25-20-3320; change value to 3.32K
A1R114:	Change Part No. to 25-20-2150; change value to 2.15K
A1R116:	Change Part No. to 25-25-8200; change value to 8.2K

Page 5-23, Table 5-5

Add:	A2, Part No. C139-12, Power Supply
A2C10:	Change value to 50 μf
A2C15:	Change value to 2200μf

Page 5-24, Table 5-5

A2R14:	Change wattage to 0.3W
A2R15:	Change wattage to 0.3W
A2R17:	Change wattage to 0.3W
A2R30:	Change wattage to 0.3W

Page 5-25, Table 5-6

Add:	A3, Part No. C139-90, Remote Programming
A3R4:	Change resistor type to film

Page 5-26, Table 5-7

Add:	A4, Part No. C139-19, Mother Board
A4C1:	Change Part No. to 33-35-R22
A4C2:	Change Part No. to 33-35-R22
A4J1:	Change Part No. to 62-152
A4J2:	Change Part No. to 62-152
A4J3:	Change Part No. to 62-152
A4J4:	Change Part No. to 62-152
A4R9:	Change Part No. to 25-15-4700
A4R10:	Change wattage to 0.3W
A4R11:	Change wattage to 0.3W
A4R12:	Change wattage to 0.3W
A4R13:	Change wattage to 0.3W

Page 5-27, Table 5-7

A4R21:	Change Part No. to 25-20-2550
A4A1R1:	Change wattage to 0.3W
A4A2R2:	Change resistor type to film
Add:	A4S1R1, P/O 56-71, Res, variable, 10K

Table 5-8

Add:	A5, Part No. C139-131, Trimmer Board

Page 3-3, Figure 3-1

Line (E):	Change description to read: Selects one of nine calibrated sweep widths. Vernier control provides adjustment of the sweep width in 0 – 100% position only.

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Table 1-1. Specifications *

FREQUENCY
Range, accuracy, linearity and stability are determined by RF Unit installed.

SWEEP FUNCTIONS
Sweep End Limits: Any two frequencies in band set by F1 and F2 controls. Sweeps in either direction from F1 to F2.

Marker End Limits: Any two frequencies in entire band set by M1 and M2 controls.

Symmetrical Sweep: Center frequency set by either M1 control or an external 10 k-ohm potentiometer. Sweep width adjustable from 0 to 100% of entire band with continuous, uncalibrated control or in nine discrete widths calibrated directly in MHz or GHz, from about 0.25% to 100% of band. Width accuracy is ±3% of sweep width.

External: Direct coupled 10 V for full sweep; positive voltage increases output frequency. Response time: 1 msec for full sweep. Provision for external resistance programming. Input impedance 5 k-ohms.

CW Operation: Continuously variable single frequency controlled by position of M1 marker. Externally controllable with either 10 K-ohm potentiometer or an analog voltage between 0 and +10 volts.

MARKERS
Two independent, adjustable calibrated markers displayed either as dips in RF output or externally as video markers. Constant proportion width marker selectable for sharp, bright marking in narrow-width symmetrical displays.

Accuracy: Same as RF Unit frequency accuracy.

Resolution: Better than 0.05% of RF Unit bandwidth.

Amplitude: Continuously variable.

Output: Auxiliary video marker; amplitude −5V. Output impedance 5 K-ohms.

TRIGGERED SWEEP MODES
Automatic: Sweep recurs automatically.

Line: Line frequency triggers sweep.

External: −10 V input initiates sweep.

Single Sweep: Front panel momentary switch starts sweep.

SWEEP RATES
Automatic: Four decade ranges continuously adjustable from 0.01 sec/sweep to 100 sec/sweep. Vernier has 10 to 1 range.

Manual: Three-quarter-turn control for sweep between limits set in either end-limit or symmetrical sweep modes.

Sweep Dwell Time: Delay at start to allow RF power level to stabilize. Also, delayed at end of sweep.

SWEEP OUTPUT
Direct-coupled, constant amplitude sawtooth adjustable from 0 to +10 V peak, concurrent with swept RF output. Sweep lamp lights only during forward sweep.

PROPORTIONAL OUTPUT
Switchable between:

a. Direct-coupled voltage proportional to instantaneous frequency. 0 V at low end and 10 V at high end of band.

b. Direct coupled voltage proportional to instantaneous frequency. 0 V at low end and 40 V/ octave at high end of band.

BLANKING
Operation: RF automatically off during retrace to provide base line except when disabled with rear panel switch.

Output: Direct-coupled-5 V pulse; impedance 5 k-ohms.

PEN LIFT OUTPUT
Relay contact closure during forward-trace portion of sweep.

RF OUTPUT
Leveling: With internal leveling, power variation is as indicated for RF unit. With an external directional coupler and detector, the internal feedback amplifier maintains output power variation to within ±0.05 dB, plus coupler and detector variation. Provision for power meter leveling from + or − meter output. Leveling input impedance is 1 K-ohms.

Amplitude: RF level controlled from front panel or with external 10 K-ohm potentiometer or an analog input voltage.

RF Level On/Off: Front panel switch permits complete RF cut off. Rear panel binary input permits remote control.

MODULATION
Amplitude Modulation:

Internal: Square wave adjustable from 950 to 1050 Hz with rise time of 2 μsec maximum. On/off ratio greater than 40 dB.

External: +10 V signal increases RF output to rated level with RF level control set at minimum. Rise and fall time <1.0 μsec unleveled and leveled. Source impedance, 10 K-ohms.

Frequency Modulation: Direct-coupled wide-band FM input with maximum deviation rate determined by RF unit.

Pulse: Optional pulse input on rear panel is provided for < 50 nsec pulse rise time.

SPURIOUS SIGNALS
60 dB below rated RF output (50 dB for Models 438A and B), except 2nd harmonic is 20 dB to 8 GHz and 30 dB from 8 to 18 GHz.

GENERAL
Dimensions: 5-5/8"H, 16-3/4"W, 12-3/4"D

Weight (Mainframe only): Net 25 lbs., approximately.

Power Input: 115/230 V ± 10%, 48 - 420 Hz, approximately 100 VA.

*** Model 430A with any RF Unit installed.**

SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains information necessary for understanding the application and operation of the Weinschel Engineering Model 430A Sweep Oscillator (Mainframe). The manual provides a general description, installation information, operation instructions, principles of operation and maintenance information. A complete set of schematic diagrams is also provided to aid in understanding the various modes of operation and proper servicing of the equipment.

The Model 430A Sweep Oscillator accepts a series of solid-state plug-in RF Units. Figure 1-1 shows the Model 430A with a Model 433A RF Unit installed. Although reference to controls, indicators and connectors located on the RF Unit are used frequently throughout the following sections, this manual does not contain a detailed discussion of the RF Unit. Refer to the applicable RF Unit instruction manual for specifications, operating instructions and maintenance information for a specific RF Unit.

Figure 1-1. Weinschel Engineering Model 430A Sweep Oscillator With a Model 433A RF Unit Installed

1.2 DESCRIPTION

The Weinschel Engineering Model 430A is a solid-state, high performance Microwave Sweep Oscillator featuring plug-in versatility and multi-band operation capability. The Model 430A and its series of RF Units provide a sweepable range of 0.01 to 18 GHz. A plug-in RF Unit is an integral part of the sweep oscillator circuitry and must be installed in the front panel compartment of the Model 430A to achieve operation. Available RF Units covering seven frequency ranges are shown in Table 1-2. All basic RF Units are designed for external leveling. Optional RF Units with either internal or no leveling are also available.

Table 1-2. RF Plug-In Units

Weinschel Engineering Model	Frequency Range (GHz)
431A,B	1 to 2
432A,B	2 to 4
433A,B	4 to 8
434A,B	8 to 12.4
435A,B	12.4 to 18
438A,B	0.01 to 2
442A,B	1.7 to 4.2

With an RF Unit installed, the Model 430A becomes a versatile electronically tunable sweep source of precision RF signals suitable for testing and calibration of RF components and systems. This high performance sweep oscillator provides stable multi-decade coverage down to 10 MHz, with exceptionally low spurious and harmonic content, and provides continuous coverage up to 18 GHz. It provides four sweep modes: automatic, external, single and manual. The automatic, external and single are adjustable in sweep time from 0.01 to 100 sec/sweep, or may be set to discrete calibrated widths. Other performance features include superior frequency accuracy, high FM rates for phase lock applications, and symmetrical sweep widths of from 0 to 100% of the frequency bands.

A single band sweep oscillator is achieved by using the Mainframe and one plug-in RF Unit. To achieve multi-band operation with a continuous sweep output requires the following accessory units:

Two or more Model 430A Series RF Units.
Model 4301A RF Unit Holder (for operation over five or more octave bands).
Model 4302A RF Unit Controller (used in conjunction with Model 4301A).
Model 4309A Interface Unit.
Model 4310A Control Unit.

The all solid-state design of the Model 430A, including the oscillators, makes it a light weight unit that provides convenient portability for field operations. Since each RF Unit covers a specific frequency range, a separate high resolution, 14-inch frequency scale is provided with each unit. These scales are keyed to the mainframe to ensure accurate positioning.

The Model 430A Microwave Sweep Oscillator is the key element in a complete microwave parameter measuring system and is compatible with all Weinschel measuring instruments and systems.

SECTION 2
INSTALLATION

2.1 UNPACKING

The Weinschel Engineering Model 430A Sweep Oscillator is shipped in a double carton with two inches of packing material between the inner and outer cartons. Use normal care when unpacking the instrument and removing the packing material. Do not destroy the cartons or packing material until the equipment is thoroughly inspected. If damage is found, notify the carrier immediately and do not destroy any packing material until an agent of the carrier has examined it. Under U. S. shipping regulations, damage claims must be collected by the consignee; do not return the instrument to Weinschel Engineering until a claim for damages has been established.

2.2 POWER CONSIDERATIONS

2.2.1 Power Source

The Model 430A may be operated from an AC source of 115 or 230 volts (± 10%), at 48 to 420 Hz. With the instrument power cord disconnected, move the Line Voltage Selector switch (located on the rear panel) with the aid of a narrow blade screwdriver until the desired voltage number, 115 or 230 is visible. Fuse F1 located on the rear panel must be 3 amperes for 115 volts operation or 1.5 amperes for 230 volts operation.

2.2.2 Power Cord

The Model 430A is supplied with a detachable, three-conductor power cord. This power cord, when plugged into an appropriate receptacle, grounds the instrument cabinet as recommended by the National Electrical Manufacturer's Association (NEMA) for the protection of operating personnel. To preserve the protection feature when using a two-contact type outlet, use a three-conductor to two-conductor adapter and connect the adapter lead to the receptacle plate.

2.3 OPERATING TEMPERATURE RANGE

The Model 430A is designed to operate within its specifications when the ambient temperature is between – 10°C and +50°C. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and cause damage to its circuits.

2.4 RACK BENCH CONVERSION

The Model 430A is shipped as a bench-type instrument. For bench use the unit is conveniently raised on its four plastic feet. A self-storing tiltstand may be locked into position to further raise the front panel for improved viewing.

To prepare the unit for rack mounting, remove feet and tiltstand, install rack adapters and filler strip as illustrated in Figure 2-1. Rack adapters and a filler strip are supplied as an Accessory Kit.

2.5 REPACKING FOR SHIPMENT

To protect the unit during reshipment always use the best packaging methods available. When possible, use the original packing containers and cushioning material. Make certain the plug-in RF Unit is securely locked in position and held there by cushioning material, if installed in the Model 430A during shipment. If the original packing materials are not available use the following procedure:

a. Wrap instrument in sturdy paper or plastic.

b. Place wrapped instrument in a strong shipping container; use a ¾-inch layer of shock absorbing material around all sides of the unit to provide a firm cushion and prevent movement inside the container.

c. Thoroughly seal shipping container and mark it as "FRAGILE".

d. If shipping for service attach a tag to indicate:

1. Service required.
2. Description of malfunction.
3. Model and Serial numbers.
4. Return address.
5. Authorization to conduct repairs.

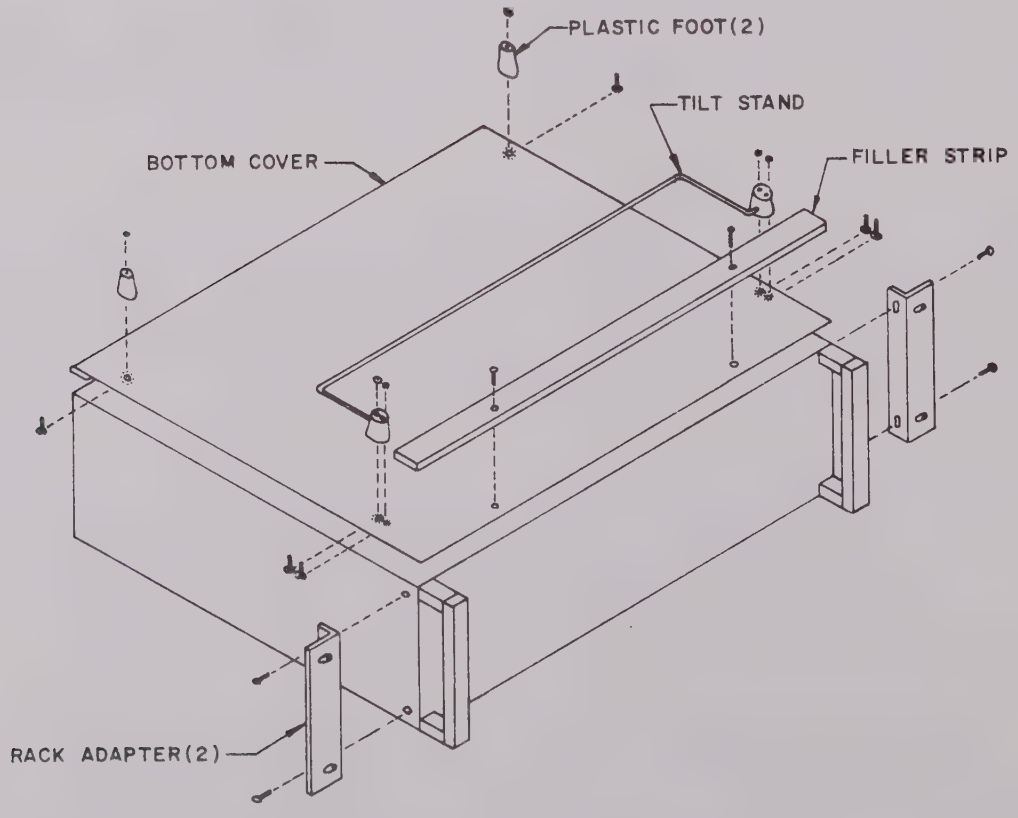


Figure 2-1. Conversion for Rack Mounting

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides a detailed description of the Model 430A Sweep Oscillator's operating controls, indicators and connectors, and contains the procedures for operating the instrument. This section also describes the controls and indicators located on the RF Unit. (Refer to the applicable RF Unit Instruction Manual for a detailed description of the unit.)

The Model 430A, a versatile RF signal source of both swept and static frequencies provides four sweep modes: automatic, single, manual and external. The Mainframe and seven basic RF units (See Table 1-2) provide a continuous range of coverage from 0.01 to 18 GHz.

3.2 FRONT AND REAR PANEL FAMILIARIZATION

3.2.1 Front Panel

Figure 3-1 illustrates and explains the function of all front panel fixtures for both the Mainframe (encircled numbers) and an RF Unit (encircled letters). Additional information regarding the proper use of the controls is provided in paragraphs 3.3 through 3.15.

3.2.2 Rear Panel

The identification and function of connectors and controls located on the rear panel for both the Mainframe (encircled numbers) and an RF Unit (encircled letters) are shown in Figure 3-2.

3.3 OPERATING CONSIDERATIONS

Information regarding operating features of the Model 430A along with controls on the RF plug-in Unit is provided in the following paragraphs. A complete understanding of these considerations and their effects is recommended before using the instrument as a signal source.

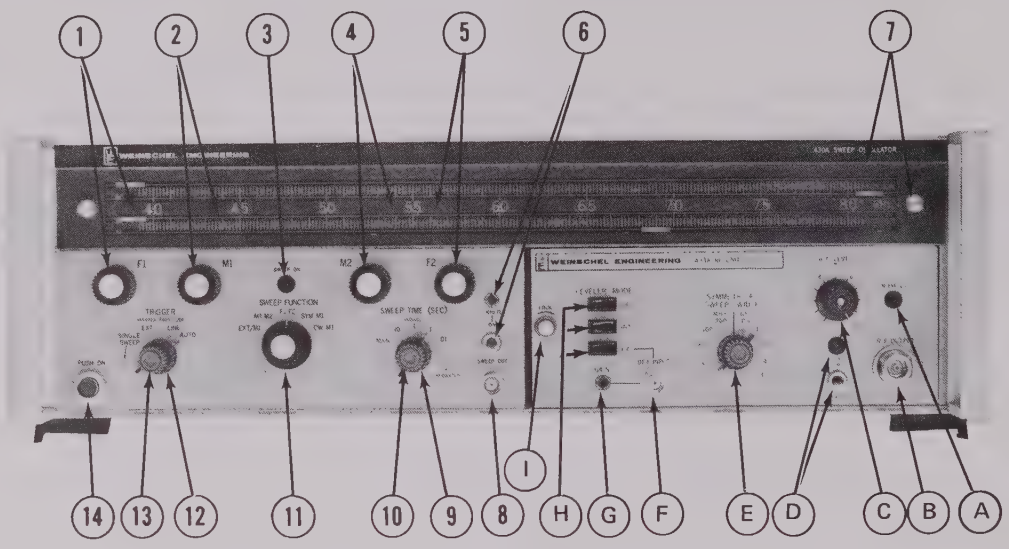
3.4 APPLYING POWER

Momentarily depressing the PUSH ON pushbutton causes the pushbutton to light indicating that the Model 430A is ready to operate providing a RF Unit is installed. There is no waiting period for operation. (Depressing the pushbutton a second time will turn off the instrument.)

3.5 SWEEP MODES

3.5.1 Automatic

One of four automatic sweep times can be selected by setting the SWEEP TIME (SEC) control to either .01, .1,1, or 10 and setting the SWEEP FUNCTION control to M1-M2, F1-F2 or SYM M1. The SWEEP TIME (SEC) settings are only accurate providing the VARIABLE control is set to CALIBRATED



(1) **F1 Control and Marker:** Determines starting frequency for F1-F2 setting of SWEEP FUNCTION control and marker frequency in remaining settings except for CW M1.

(2) **M1 Control and Marker:** Determines (a) marker frequency for F1-F2, (b) sweep starting frequency for M1-M2, (c) center frequency for SYM M1, and (d) sweep starting frequency for EXT/M1 positions of SWEEP FUNCTION control.

(3) **SWEEP ON:** Indicator lights during forward trace of internally generated sweep, but is inoperative in manual sweep mode.

(4) **M2 Control and Marker:** Determines (a) second marker frequency for F1-F2, (b) the only marker frequency for EXT/M1, and (c) sweep limit frequency for M1-M2 positions of SWEEP FUNCTION.

(5) **F2 Control and Marker:** Determines (a) sweep limit frequency for F1-F2, and (b) marker frequency for both M1-M2 and SYM M1 settings of SWEEP FUNCTION.

(6) **1KHz ⊓⊔ ON Switch and Adjustment:** Controls voltage to square wave generator; adjustment varies frequency of square wave.

Figure 3-1. Front Panel Description

(7) **Frequency Scale and Retaining Screws:** Fourteen-inch scale (one per RF Unit)

(8) **SWEEP OUT:** Connector provides a Linear dc ramp voltage for driving the horizontal axis of oscilloscopes and chart recorders.

(9) **SWEEP TIME (SEC):** Selects one of four sweep times; also selects manual mode.

(10) **SWEEP TIME (SEC) VARIABLE:** Vernier provides adjustment of selected sweep time; Fully CCW setting increases sweep time by a factor of 10. In the Manual mode, the vernier is used to manually vary the sweep.

(11) **SWEEP FUNCTION:** Selects an internal mode, CW or external frequency (voltage) command.

(12) **TRIGGER:** Selects either AUTO, LINE or EXT mode for generating the sweep.

(13) **MARKER AMPLITUDE:** Provides continuous amplitude adjustment for video and RF markers.

(14) **PUSH ON:** Controls ac line power; depress once for ON and a second time for OFF.

(A) **UNLEVELED:** Indicator lights when RF output is not leveled across the entire frequency range.

(B) **RF OUTPUT:** Connector provides RF OUTPUT signal.

(C) **RF LEVEL Controls:** Knob sets amplitude of RF OUTPUT: screwdriver adjustment standarizes control action for various external detectors.

(D) **RF ON-OFF Switch and Indicator:** Controls V_{CC} to RF Unit; indicator lights when RF Unit is operating.

(E) **SYMMETRICAL SWEEP WIDTH Controls:** Select one of nine calibrated sweep widths; vernier provides adjustment of the selected width.

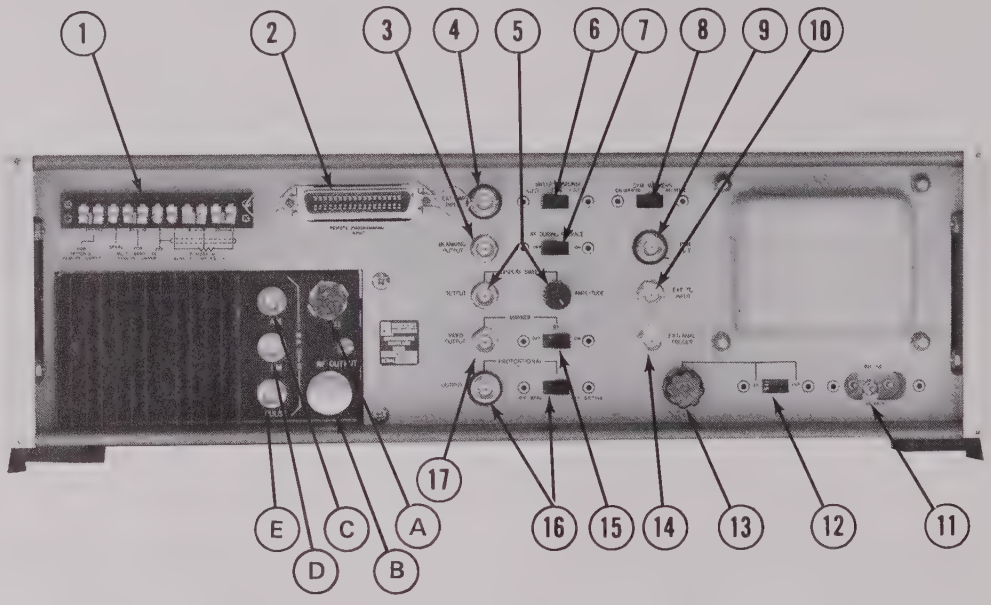
(F) **EXT DET INPUT:** Input connector for external leveling signal.

(G) **GAIN:** Adjustment controls Leveler gain in the Power Meter mode.

(H) **LEVELER MODE Controls:** Selects one of three basic modes of operation: OFF, INTernal or EXTernal. (Internal leveling available only with –01 option.

(I) **LOCK:** Captive screw secures RF Unit in Mainframe.

Figure 3-1. Front Panel Description (Cont.)



1. **TB1:** Terminals 1,2,3 (auxiliary); 4 and 5 (normally shorted); 6 thru 11 (remote frequency control)

2. **REMOTE PROGRAM INPUT:** Input connector for remote digital BCD control of output frequency and remote RF ON/OFF Control.

3. **BLANKING OUTPUT:** Connector provides a negative pulse during retrace and prior to initiation on next trace.

4. **EXT SWEEP INPUT:** Input connector for 0 to +10 volt input sweep command.

5. **DISPLAY SWEEP OUTPUT and AMPLITUDE:** Output is identical to front panel SWEEP OUT; control adjusts amplitude of both front and rear panel SWEEP OUTPUT signals.

6. **SWEEP RESPONSE TIME:** Switch controls bandwidth of tunning supply. In AUTO the bandwidth is automatically adjusted according to rate of change of the input voltage; in FAST the bandwidth always remains in its widest bandwidth.

Figure 3-2. Rear Panel Description

(7) **RF DURING TRACE:** Switch provides a choice of RF ON or OFF during retrace.

(8) **SYM MARKERS:** Switch Selects CALIBRATED MARKERS, read from the frequency scale, or RELATIVE markers of constant narrow width in SYM M1 mode.

(9) **PEN LIFT:** Terminal provides a relay closure signal during forward trace.

(10) **EXT SQUARE WAVE:** Input connector for external RF modulation square wave for RF Modulation; — 10 volts turns off RF power.

(11) **LINE INPUT:** 3 - wire male connector.

(12) **Line Voltage:** Switch Sets Model 430A for 115V or 230V operation.

(13) **Power Line Fuse:** 115V/3A or 230V/1.5A.

(14) **EXTERNAL TRIGGER:** Connector for —10 volt input trigger signals.

(15) **RF MARKER:** Switch Provides amplitude dips on the RF output.

(16) **PROPORTIONAL OUTPUT and Switch:** Connector provides a voltage proportional to the instantaneous RF output. Switch selects either 10V/BAND or 40V/OCTAVE scale factor for the proportional output voltage.

(17) **VIDEO MARKER OUTPUT:** Connector provides a negative signal when the RF and marker frequencies coincide. RF MARKER switch does not affect this output.

(A) **J1:** Input connector for a remote tuning input.

(B) **RF OUTPUT:** This connector only present on RF Units with "R" option.

(C) **AM INPUT:** Input connector for amplitude modulation signals.

(D) **FM INPUT:** Input connector for frequency modulation signals and phase locking signals.

(E) **PULSE INPUT:** Input connector for pulse signals which provide a rise and fall time < 50 ns. (Only available with the — 02 option.)

Figure 3-2. Rear Panel Description (Cont.)

(fully clockwise). Rotating the VARIABLE control from fully clockwise to fully counterclockwise increases the sweep time from zero to ten times the interval indicated .01, .1, 1, or 10) with a maximum sweep time of 100 seconds. The SWEEP ON indicator will light during a forward portion of the sweep.

3.6 SWEEP TRIGGER SELECTION

3.6.1 Automatic

With the TRIGGER selector set to AUTO, the sweep is automatically generated upon completion of a retrace, i.e. recurrent free-running operation. A short dwell time is provided at the start and finish of each trace for equilibration.

3.6.2 Line

In the LINE position, a sweep is triggered by the occurrance of the next line frequency cycle following completion of retrace.

3.6.3 External

Setting the TRIGGER selector to EXT allows a −10 volt signal, applied to the EXTERNAL TRIGGER connector on the rear panel, to trigger a new sweep upon a receipt of the next negative going external trigger signal following completion of retrace.

3.6.4 Single Sweep

Rotating the TRIGGER selector fully counterclockwise generates a single sweep. The control is spring loaded and will not remain in the SINGLE SWEEP position. A second manual sweep can be initiated by rotating the selector fully counterclockwise again following completion of retrace.

3.7 SWEEP FUNCTION MODES

3.7.1 F1-F2 Mode

With the SWEEP FUNCTION selector set to F1-F2, the output frequency sweeps between the limits set by the F1 and F2 controls. Normally the low frequency limit is set by F1 and the high limit by F2, resulting in a sweep that goes from a low to a higher frequency. However, F1 can be used to set the high limit and the F2 marker used for the low limit, thereby establishing a high to low frequency sweep.

Two calibrated markers are controlled by the F1 and F2 controls, each continuously adjustable over the entire frequency range.

3.7.2 M1-M2 Mode (Expanded Sweep)

The M1-M2 markers provide the means of selecting any portion of the F1-F2 frequency range for expanded display. With the SWEEP FUNCTION selector set to M1-M2, adjust the M1 and M2 controls to position the M1 and M2 markers at either side of the range to be expanded. The frequency range established by the two markers is now the full width of the swept frequency display.

3.7.3 SYM-M1 Mode (Symmetrical Sweep)

Setting the SWEEP FUNCTION selector to SYM M1 and adjusting the M1 control to position the M1 marker to the desired frequency will cause the trace to sweep symmetrically about the center frequency established by M1. The total sweep width (peak-to-peak excursion) is determined by the setting of the SYMMETRICAL SWEEP WIDTH control located on the front panel of the RF Unit.

When the SYM MARKERS switch located on the rear panel is set to CALIBRATED, F1 and F2 markers are directly calibrated by the frequency scale and cover the entire frequency range of the RF Unit. Positioning the SYM MARKERS switch to RELATIVE causes the markers to become quite narrow ranging only over the symmetrical sweep frequency width in use.

The symmetrical mode is convenient for making narrow-band measurements since the frequency excursion is calibrated to within ±3% of the SYMMETRICAL SWEEP WIDTH range selected. For narrow sweep width this is substantially more accurate than the markers. The SYMMETRICAL SWEEP WIDTH selector provides nine convenient steps from approximately 0.2% to 100% of the sweep range for the RF Unit. Rotating the selector fully clockwise activates the concentric control which is used to continuously vary the sweep width over the full frequency range.

The symmetrical mode may also be used as an expansion of the F1-F2 mode, when the M1 marker is set to the center of that portion of the F1-F2 display to be expanded.

The center frequency may also be remotely programmed via the terminal strip (①, Figure 3-2) located on the rear panel. When jumpers linking terminals 8 to 9 and 10 to 11 are removed, remote voltage from 0 to −10 volts (applied to terminal 9 with respect to terminal 7) will linearly control the center frequency over the full range. A potentiometer (1K recommended) or a resistor divider placed at terminals 7, 9 and 11 will also determine the center frequency over its full range.

If several center frequencies are required, an external switch or pushbutton control can be used to select from a number of remote programming voltages, potentiometers or resistor divider networks.

3.7.4 CW M1 Mode

When the SWEEP FUNCTION selector is set to the CW M1 position the automatic sweep mode is disabled and the output frequency is determined by the setting of the M1 control. The SWEEP ON indicator does not function in this mode.

With the SWEEP FUNCTION selector set to F1-F2, the M1 marker may be preset to a frequency of interest. When the SWEEP FUNCTION selector is placed in the CW M1 position the sweep will automatically stop at the frequency identified by the position of the M1 marker.

Remote frequency programming may be accomplished via the rear terminal strip as described in paragraph 3.15.

3.7.5 EXT/M1 Mode

When the SWEEP FUNCTION selector is set to the EXT/M1 position the automatic sweep is disabled and the output frequency is determined by an external voltage applied to the EXT SWEEP INPUT connector (located on the rear panel) and the setting of the M1 control. An analog voltage from 0 to +10 volts will control the frequency over the entire range of the RF Unit. The SWEEP ON indicator does not function in this mode.

One calibrated marker, M1, is controlled by the M1 control and is continuously adjustable over the entire range.

3.8 SWEEP RESPONSE TIME CONTROL

With the SWEEP RESPONSE switch (located on the rear panel) set to AUTO, the response (bandwidth) of the tunning supply is automatically adjusted according to the rate of change of the input

tuning voltage – whether internally or externally generated. In this manner a minimum noise bandwidth is maintained to ensure the lowest possible residual FM regardless of sweep rate. Setting the SWEEP RESPONSE to FAST forces the bandwidth to remain at its widest width at all times.

3.9 RF LEVEL

The continuously variable RF LEVEL control (front panel) is used to vary the amplitude of the RF output. Maximum RF output level is obtained by rotating the RF LEVEL fully clockwise. The screwdriver adjustment located in the center of the RF LEVEL control is used to optimize RF output performance. Setting of this adjustment is explained in the appropriate RF Unit Instruction Manual. The LEVELER MODE OFF pushbutton should be depressed unless leveled power is to be used.

3.10 RF POWER LEVELING

3.10.1 General Considerations

The Model 430A with any RF Unit installed is capable of maintaining a constant amplitude RF output across the frequency range. This is accomplished by comparing the dc level from an RF amplitude sampling device with the amplitude command of the RF LEVEL control. The difference (or error) is amplified and applied to a voltage attenuator which reduces the amplitude of the RF output to the desired level.

The RF LEVEL control sets the maximum amplitude of RF power across the frequency range. Consequently, the RF output will be leveled in those portions of the frequency band where there is sufficient RF power but will remain unleveled in any portion where the amplitude of the RF power falls below the level established by the RF LEVEL control. The UNLEVELED indicator will only be illuminated during those portions of the sweep that are not leveled.

The RF LEVEL control may be adjusted to obtain a leveled output across the entire frequency range or, if required, may be set to obtain a leveled output only over that portion of the range where the amplitude of the RF power is higher. Since minimum power output usually occurs at one end of the frequency range, the RF LEVEL control should be adjusted for leveled operation at that end of the range to obtain leveled operation across the entire frequency range.

3.10.2 Internal Leveling

No external equipment is required to provide leveled RF power when using an RF Unit featuring internal leveling circuitry. These units have an internal directional detector consisting of a flat broadband directional coupler with a crystal detector. To activate the internal leveling function, simply depress the front panel LEVELER MODE INT pushbutton and adjust the RF LEVEL control as discussed in paragraph 3.10.1.

3.10.3 External Crystal Leveling

The output from any RF Unit may be leveled (except for those units with the –2 option) by using a remote RF amplitude sampler. This is especially desirable at the higher microwave frequencies to assure flat power at the input to the device under test. External leveling is also used to remove any power variations which may otherwise be introduced by a device inserted in the RF path such as a filter, an amplifier or a long transmission line.

For sweeping at high speeds to obtain a flicker-free oscilloscope display, depress the LEVELER MODE EXT pushbutton. In this mode the leveling system may be used with a directional coupler (typically 10 dB) and a flat broadband crystal detector. A directional detector consisting of a coupler crystal

detector combination in a single package may also be used.

For optimum results over a frequency range of less than 2:1, a low pass filter with cutoff frequency at the high end of the desired band may be inserted before the directional coupler. The influence which any small harmonic content of the RF signal might have on leveling is thus prevented.

3.10.4 Power Meter Leveling

The ultimate in leveling accuracy and flatness across a broad band is obtained by substituting a RF power meter for the crystal detector as discussed in paragraph 3.10.3. The long response time, however, of power meter thermistor mounts restricts Sweep Time selection to the two slower ranges, 1 SEC and 10 SEC, of the SWEEP TIME (SEC) control. These two ranges are also suitable for use in conjunction with an X-Y recorder or with oscilloscopes other than the long persistence display types.

The power meter should have a minimum output of 1 volt or 1 milliampere. Either polarity may be used. Typically, a 10 dB directional coupler and a low pass filter are used in the same manner described in paragraph 3.10.3. A leveled output power indication is calculated by adding the directional coupler's coupling factor in dB to the power meter indication. The output power indication is influenced by both the front panel RF LEVEL control setting, and on the range selected for the power meter. It might be necessary to readjust the GAIN control when changing settings of the power meter range switch.

When square wave modulation is used the leveling action of the power meter maintains constant (average) power. Since the duty factor of the internal square wave is 50%, the peak RF power will be twice the value indicated by the average reading on the power meter.

To minimize transients at the start of sweep, it is recommended that the RF DURING RETRACE switch (located on the rear panel) be placed to ON. Refer to paragraph 3.12 for more details.

3.11 FREQUENCY MARKERS

Two independent calibrated frequency markers are generated for each sweep mode except for the EXT/M1 mode. These markers are available as negative video signals at the VIDEO MARKER OUTPUT connector located on the rear panel. The marker waveforms may be displayed on the second channel of a dual trace oscilloscope, on an X-Y recorder, used as an oscilloscope intensity variation signal or used to activate systems such as a network analyzer.

Placing the RF MARKER switch (rear panel) to ON causes the RF Markers to be displayed as a sharp dip in RF power. Marker amplitude is varied by the continuously adjustable MARKER AMPLITUDE control located on the front panel.

3.12 BLANKING DURING RETRACE

When the RF DURING RETRACE switch (rear panel) is set to OFF, the RF power is turned off during retrace of the internally generated sweep. This feature provides a zero power reference base line for the RF display. Dwell time is also provided at both start and finish of sweep. Setting the switch to ON provides RF power during both trace and retrace. This is useful for power meter leveling setups and for chart recorder operation since it eliminates large changes in amplitude at the beginning and end of sweep.

A negative video pulse coincident with the retrace is present at the BLANKING OUTPUT connector. In addition, a contact closure during forward trace is available at the PEN LIFT terminals for use with recorders having the capability to discontinue writing during retrace. The PEN LIFT terminals automatically remain open in MANual sweep mode, the .1 and .01 SEC SWEEP TIME settings and when primary power is off.

3.13 AMPLITUDE MODULATION

3.13.1 Internal Square Wave

The internal 1KHz square wave generator, especially useful with a tuned detection amplifier, may be activated in any mode by setting the 1KHz⎍⎍ switch to ON. The associated front panel screwdriver adjustment provides the means to change the frequency over a range from 950 to 1050 Hz. The oscillator which provides 100% modulation has a peak power value identical with square wave off power in Leveling OFF or XTAL. In the power meter leveling mode, the average power remains the same and may require resetting the RF LEVEL control to maintain peak power within the RF Units maximum output capability.

3.13.2 External AM

An external amplitude modulating signal may be applied to the AM INPUT connector located on the rear panel of the RF Unit. External modulation signals are mixed directly with the output of the RF LEVEL control circuit. Amplutude distortion of the modulation is minimum when XTAL leveling is used. Power will remain linear with an external amplitude modulating signal when power meter leveling is employed, but frequency response is somewhat limited. Adjusting the RF LEVEL control will center the dynamic range of the amplitude modulating input signals.

3.13.3 External Pulse

Pulse modulation input signals are applied to the PULSE INPUT connector on the rear panel of the RF Unit. When this input is being used, make sure the RF LEVEL control is rotated fully counterclockwise to insure that the RF amplitude remains low except during a pulse. The LEVELER MODE OFF pushbutton must be depressed.

3.14 DISPLAYING SWEPT FREQUENCY MEASUREMENTS

For rapid evaluation or adjustment of a device under test, the oscilloscope is generally the most convenient display method. A simple setup using a broadband crystal detector, a pad and an oscilloscope is illustrated in Figure 3-3.

The RF output after passing through the pad and the device under test is converted to a video signal by the crystal detector and applied to the vertical input of the oscilloscope. The pad is used to provide a proper source match and to reduce the power level so that the detector operates within its square law region. A sweep signal from either the front panel SWEEP OUTPUT connector or the rear panel DISPLAY SWEEP OUTPUT connector is used to provide the horizontal drive for the oscilloscope. The DISPLAY SWEEP AMPLITUDE control located on the rear panel of the Model 430A or the horizontal gain control on the oscilloscope may be used to adjust the display width.

Measurements will be enhanced by leveling, as discussed in paragraph 3.10.

The X-Y recorder may also be used to obtain a permanent record of the evaluation or adjustment of the device under test. As shown in Figure 3-4, the test setup using the recorder is very similar to the one for the oscilloscope. The SWEEP TIME (SEC) control must be set to either 1 or 10 and the vernier adjusted to meet the response time of the recorder. If the recorder has a pen lift or equivalent writing enable-disable feature it should be connected to the rear panel PEN LIFT terminals on the Model 430 to prevent chart marking during retrace.

The recorder X and Y scale factors and zero suppression may be conveniently adjusted by setting the SWEEP TIME (SEC) selector to MAN and rotating the associated concentric VARIABLE control knob.

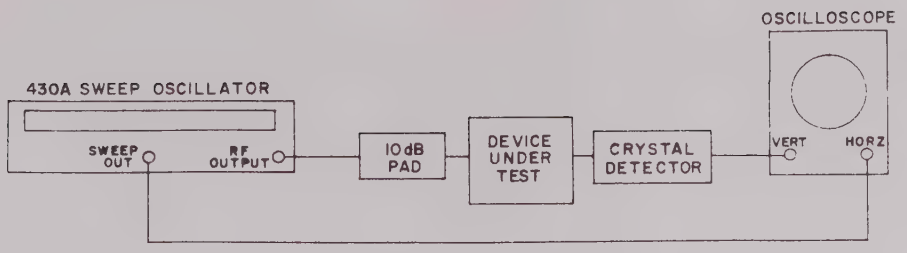


Figure 3-3. Swept Frequency Measurement Test Set-Up Using an Oscilloscope Display.

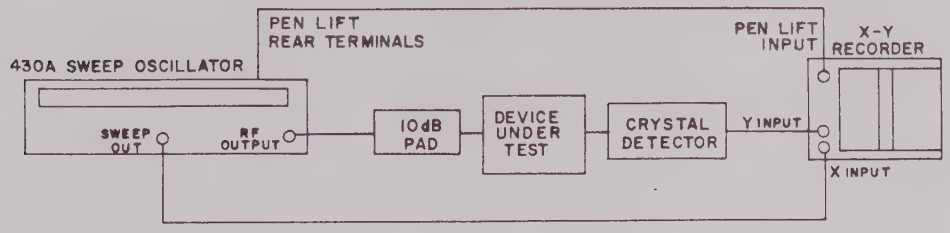


Figure 3-4. Swept Frequency Measurement Test Set-Up Using an X-Y Recorder Display.

3.15 REMOTE PROGRAMMING OF FREQUENCY AND AMPLITUDE

The Model 430A Sweep oscillator may be remotely controlled by using an external negative or positive going analog voltage, a resistance source or BCD logic level to determine the output frequency and the power level. Wideband remote frequency control e.g. phase locks, must be applied via the RF Unit rear panel FM INPUT connector. Frequency deviation is superimposed on the output frequency determined by the other inputs and controls.

3.15.1 Frequency — Analog Voltage Control

Remote control of the output frequency through the use of a 0 to +10 volt signal, that may be either dc or a special waveform, is accomplished by setting the SWEEP FUNCTION selector to EXT/M1 and applying the input control voltage to the rear panel EXT SWEEP INPUT connector. The F1 and F2 controls are inoperative but the M2 control still sets the M2 marker. In this mode the M1 control determines the 0 volt start frequency.

To affect frequency control by using a 0 to −10 volt signal requires setting the SWEEP FUNCTION selector to CW M1, or if the remote signal is being modulated then set the SWEEP FUNCTION selector to SYM M1. Remove the jumper from terminals 8 and 9 of TB-1 (located on the rear panel) and connect the input signal to terminal 9 and the signal return to terminal 7. (If a shielded cable is used connect the shield to terminal 6.) The internal electronic sweep provides a calibrated symmetrical sweep, having a width set by the SYMMETRICAL SWEEP WIDTH control located on the RF Unit, that sweeps about the center frequency determined by the input control voltage. The M1 control is ineffective; F1 and F2 controls still provide normal control over the F1 and F2 markers. If desired, the internal electronic sweep may be disabled by setting the SWEEP TIME (SEC) selector to MAN, or by setting the TRIGGER selector to EXT and positioning the SYMMETRICAL SWEEP WIDTH control to 5MHz.

Rear panel connector J1 may also be used as an input for a remote control voltage. This input may be used alone or in conjunction with any of the remote programming techniques being discussed.

A voltage applied to pins A and B (signal to B and return to A) of connector J1 operationally adds to the output frequency in every mode. This feature may be especially convenient when used as a vernier control about a preset frequency. A 10 volt change covers the entire frequency band of the RF Unit with an increase in frequency corresponding to a more positive voltage level.

3.15.2 Frequency — Resistance Control

Controlling the output frequency through an external resistance source is accomplished by connecting a resistance divider or a potentiometer (1K recommended) to terminal strip TB1 located on the rear panel. Connect the external resistance to terminals 7, 9 and 11 as illustrated just below the terminal strip. Place the SWEEP FUNCTION selector to CW M1, or if the remote signal is being modulated then set the SWEEP FUNCTION selector to SYM M1. The internal sweep provides a calibrated symmetrical sweep, having a width set by the SYMMETRICAL SWEEP WIDTH CONTROL located on the RF Unit, that sweep about the center frequency determined by the input control signal. The M1 control is ineffective; F1 and F2 controls still provide normal control over the F1 and F2 markers. The automatic sweep may be disabled by setting the SWEEP TIME (SEC) to MAN, or by setting the TRIGGER selector to EXT. Since the remote resistance divider replaces the function of the M1 control, this type of setup permits remote marker control in the F1-F2 mode, and remote sweep start control in the M1-M2 mode.

3.15.3 Frequency — Digital Control

To implement remote control via externally generated digital signals requires that the —01 option, which is a plug-in PC card, be installed in the mainframe (See Figure). The REMOTE PROGRAM INPUT connector, a 36-pin rear panel mainframe connector, provides twelve digital input lines for a remotely generated 3 digit BCD word used to determine the frequency. One input line, Remote Enable, is provided to control the mode of operation — either local or remote. A second input line is provided for strobing the 12 line 3 digit BCD input lines. If the strobe line remains open (a logic "1" condition) any 12 bit word present at the input lines will determine the output frequency. Placing a ground (a logic "O" condition) on the strobe line causes the unit to hold the last 12 bit word, regardless of the state of the 12 input lines, until the strobe line changes to a logic "1" condition. This feature allows a given 12 bit word, corresponding to a specific frequency (F_1), to be held in memory as long as the strobe input line remains at a logic O, even though the digital words on the 12 line may be changing.

One additional line is provided for remote control of the RF ON/OFF switch on the front panel of the RF Unit. Grounding this line shuts off the RF source power; leaving the line open or at +5 volts turns on the RF source power. This line is standard equipment on the Model 430A and is not part of the —01 option for the mainframe.

3.15.4 RF Amplitude — Voltage and Resistance Control

The amplitude of the RF output signal is easily controlled by simply applying a command input voltage to the AM INPUT connector located on the rear panel. An analog voltage of either 0 to +5 volts or 0 to —5 volts, will cause the amplitude to change across its entire range with a negative going voltage corresponding to a decrease in the output power level.

3.16 FREQUENCY MODULATION

3.16.1 External FM

An external frequency modulating signal may be applied to the FM INPUT connector located on the rear panel of the RF Unit. Positive going voltages cause the frequency to increase with respect to the center frequency and negative going voltages cause the frequency to decrease with respect to the center frequency. For this mode of operation, the SWEEP FUNCTION selector switch on the front panel of the Mainframe should be set to the SYM M1 position, the SWEEP TIME switch set to MAN and the SWEEP RESPONSE TIME slide switch on the rear panel of the Mainframe should be set to FAST. Set the SYMMETRICAL SWEEP WIDTH switch on the PLUG-IN Unit to the fully counter clockwise position. The M1 control will be used to set the center frequency. The input impedance at this port is approximately 5K ohms to ground. The input/output relationship for YIG tuned RF Units is determined by the model number of the RF Unit:

432A	20MHz/Volt
433A	40MHz/Volt
434A	44MHz/Volt
435A	56MHz/Volt

3.16.2 Phase Locking

Phase locking is possible by applying the error signal from the "LOCK BOX" to the FM INPUT connector.

For this mode of operation, the SWEEP FUNCTION selector switch on the front panel of the Mainframe should be set to the SYM M1 position, the SWEEP TIME switch set to MAN and the SWEEP RESPONSE TIME slide switch on the rear panel of the Mainframe should be set to FAST. Set the SYMMETRICAL SWEEP WIDTH switch on the PLUG-IN Unit to the full counter clockwise position. The M1 control will be used to set the center frequency.

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section contains a brief block level description of the Model 430A Mainframe along with a detailed description of individual circuits. These descriptions are supported by Figure 4-1, a block diagram of both the Mainframe and a generalized RF Unit, and Figures 4-2 through 4-12, simplified schematic diagrams covering selected areas of discussion. Complete schematic diagrams are provided in Section 6.

4.2 BLOCK DIAGRAM DESCRIPTION

The Model 430A Mainframe, as shown in Figure 4-1, contains sweep generating circuitry consisting of a sweep trigger, sawtooth oscillator, sweep limiter and sweep amplifiers; a frequency marker generator; a square wave generator (for internal amplitude modulation); and a power supply section for generating the various voltages required for both the mainframe and the RF Unit.

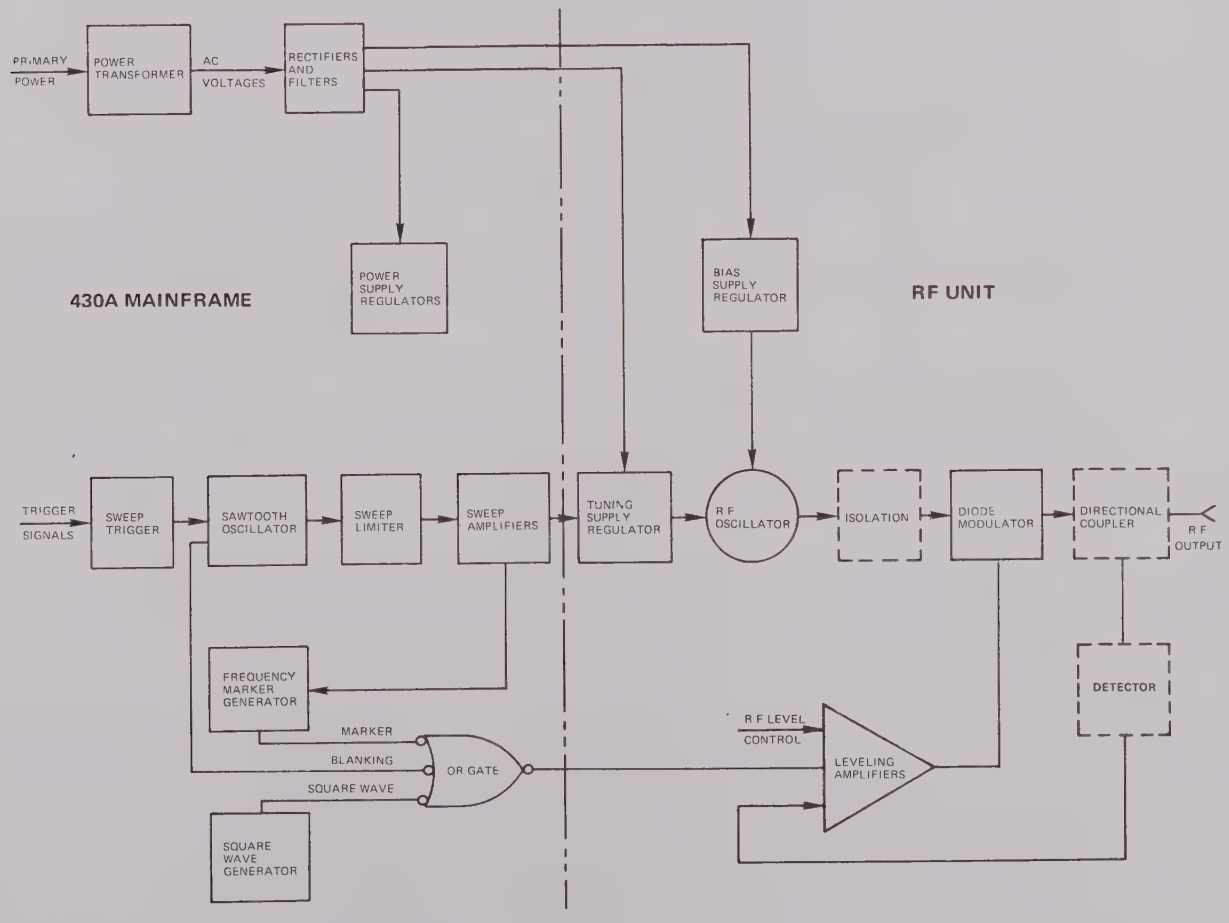


Figure 4-1. Block Diagram of Model 430A Mainframe and RF Unit

The function of the sweep trigger circuit is to reshape and standardize the negative going input trigger signal. The resultant positive output pulse is used to trigger the sawtooth generator which in turn develops a negative sawtooth voltage. This 0 to −12 volt waveform after being inverted and limited to +10 volts by the sweep limiter is applied to the sweep amplifiers which modify the positive going waveform in accordance with the front panel SWEEP FUNCTION control setting. The modified output from the sweep amplifiers is used to drive the tuning supply regulator which in turn controls the RF oscillator. As a result, the oscillator sweeps only that portion of its frequency range which corresponds to the sweep amplifiers' output waveform.

The amplitude of the RF output signal is determined by the electronically controlled attenuation of the diode modulator located in the RF Unit. The leveling amplifiers section drives the modulator with a control current determined by the setting of the RF LEVEL control. When leveling is in operation, a portion of the RF output is sampled by the directional coupler, detected and fed back to the leveling amplifiers as a negative feedback control signal. As the output frequency is varied the leveling control loop maintains the detector output at a constant level. The amplitude variation of the RF output therefore depends only on the characteristics of the directional coupler/detector combination.

The frequency marker generator circuit compares a sweep voltage with the marker control voltage to develop marker signals at the corresponding RF frequencies. The square wave generator, the retrace blanking signal and the markers, when individually activated by front or rear panel controls are gated through the OR gate and applied to the leveling amplifiers as modulation.

4.3 CIRCUIT DESCRIPTIONS (Mainframe)

The following discussion covers circuits and controls located on assemblies:

A1 – Sweep and Marker Generator
A2 – Power Supply
A4 – Motherboard
A5 – Trimmer Board

The discussion covering Assemblies A4 and A5 is not presented as a separate topic but is included as part of the A1 Assembly discussion so that the proper relationship between assemblies may be easily understood.

4.3.1 Sawtooth Oscillator (Sweep and Marker Generator)

Sweep generation is accomplished by circuitry consisting of a sweep trigger, a sawtooth oscillator, a sweep limiter and sweep amplifiers. Figure 4-2 is a simplified schematic diagram of the sawtooth oscillator whose waveform is processed to develop all internally generated sweep waveforms.

Setting the SWEEP TIME (SEC) switch (A4A2S1) to one of the four sweep time positions (.01, .1, 1 or 10) inserts a capacitor between the output and the input of IC1A which along with input resistors form an intergrator circuit. A +15V REF voltage applied to one input of IC1A via resistors A4A2R1 and A4R18 develops a 0 to −12.5 volt linear sawtooth output.

Integrator action is transferred from a forward trace to a retrace when the Binary section (bistable multivibrator) is in the reset condition. During forward trace Q3 is conducting and Q4 is cutoff. However, when the output from IC1A reaches −12 volts a comparator consisting of R24, R27 and CR7 drives the base of Q4 negative causing it to conduct. This action resets the binary circuitry and turns Q3 off. The resulting negative potential on the collector of Q3 sets up a large recharging current which flows through R22 and CR 8 to the integrator which causes it to retrace by reversing the direction of the current flow. Diode CR11 terminates the sawtooth retrace at approximately zero volts.

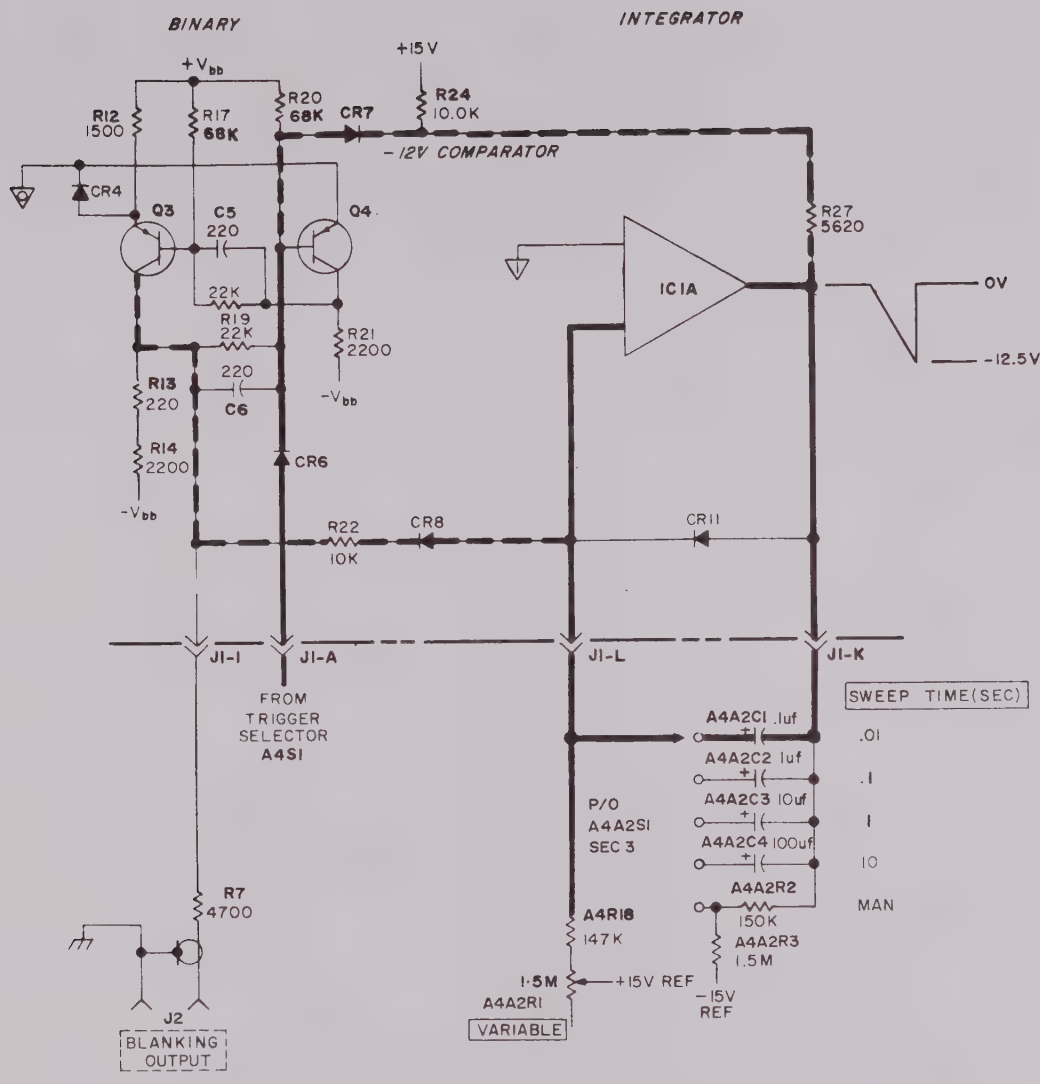


Figure 4-2. Sawtooth Oscillator, Simplified Schematic Diagram

External or internal trigger signals selected by switch A4S1, are applied through CR6 to the base of Q4. This sets the Q3/Q4 multibrator and initiates the next forward trace and the process is repeated. process is repeated.

Generation of the blanking waveform is accomplished by using the collector output from Q3. The collector potential is zero during trace and goes negative during retrace. Resistor R7 is used to provide isolation for the BLANKING OUTPUT signal at J2.

Setting switch A4A2S1 to MAN removes the capacitor from the feedback circuit of IC1A and replaces it with resistor A4A2R2. This allows the output level from IC1A to be manually varied from 0 to −12.5 volts which causes the sweep to move at the same rate.

NOTE

The following paragraph covers details not included on the simplified schematic diagram of the sawtooth oscillator. For a better understanding it is recommended that Figure 6-4 be used as reference.

Transistor A4Q1, a lamp driver, is turned on every time Q3 conducts. When A4Q1 conducts, SWEEP ON indicator DS2 is lighted indicating that an internally generated sweep in in progress. Normally open relay A4K1 (Pen Lift) is energized when A4A2S1 is set to either the 1 or 10 (SEC) position. In these positions, transistor Q5 conducts through Section 1 of A4A2S1 to energize A4K1. With A4A2S1 set to MAN, the tap on Q3's collector load is put at approximately zero volts which holds the Binary section in its forward trace state without illuminating the SWEEP ON indicator. In addition to the arm of A4A2S1, Section 3, which selects the capacitor or resistor for the feedback circuit, another arm is also used to automatically provide a discharge path for each integrator capacitor when changing between sweep range settings. It should be noted the RF DURING RETRACE switch (S4) which applies blanking signals to the OR gate depicted in Figure 4-1 is set to OFF.

4.3.2 Sweep Limiter (Sweep and Marker Generator)

Dwell time is provided at the start and finish of the internally generated sweep by limiting the sawtooth so that its sharp peak is flattened as indicated in Figure 4-3, a simplified schematic of the Sweep Limiter section.

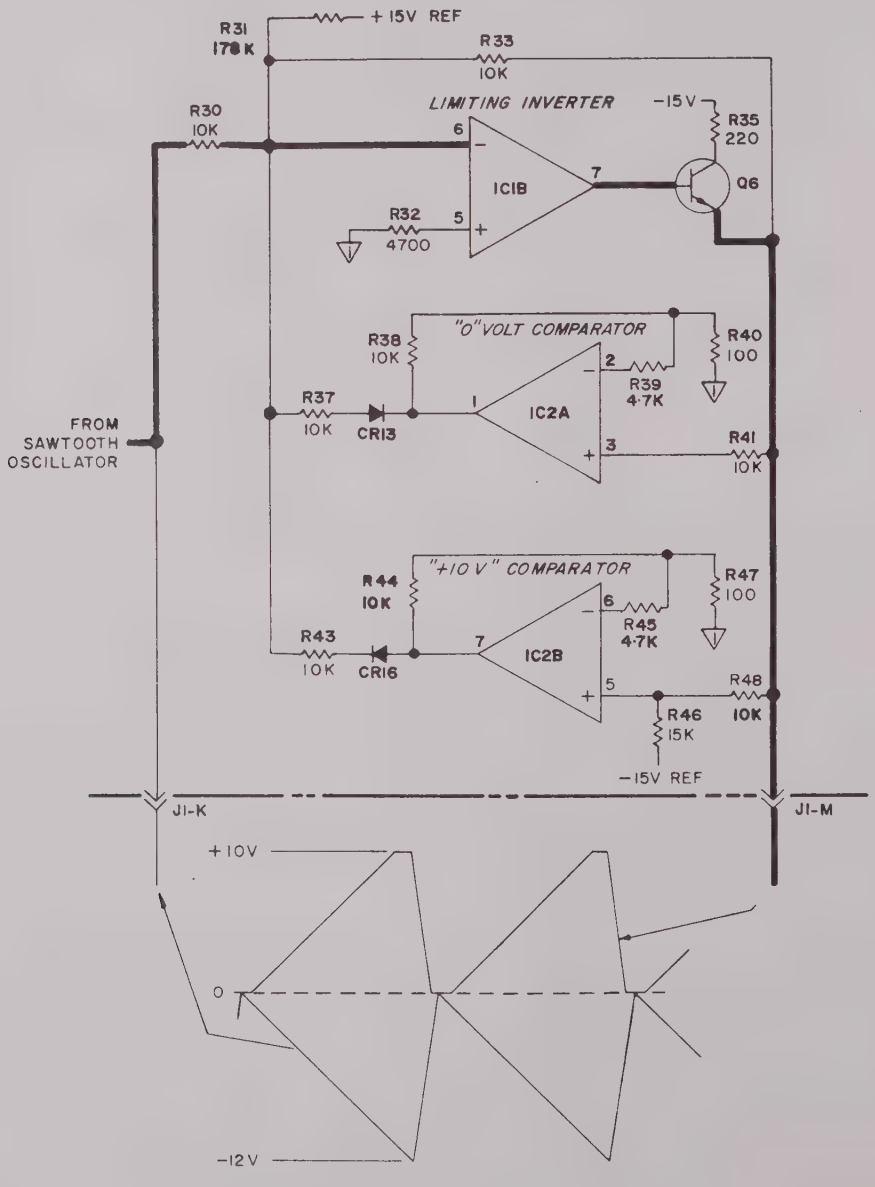


Figure 4-3. Sweep Limiter, Simplified Schematic Diagram

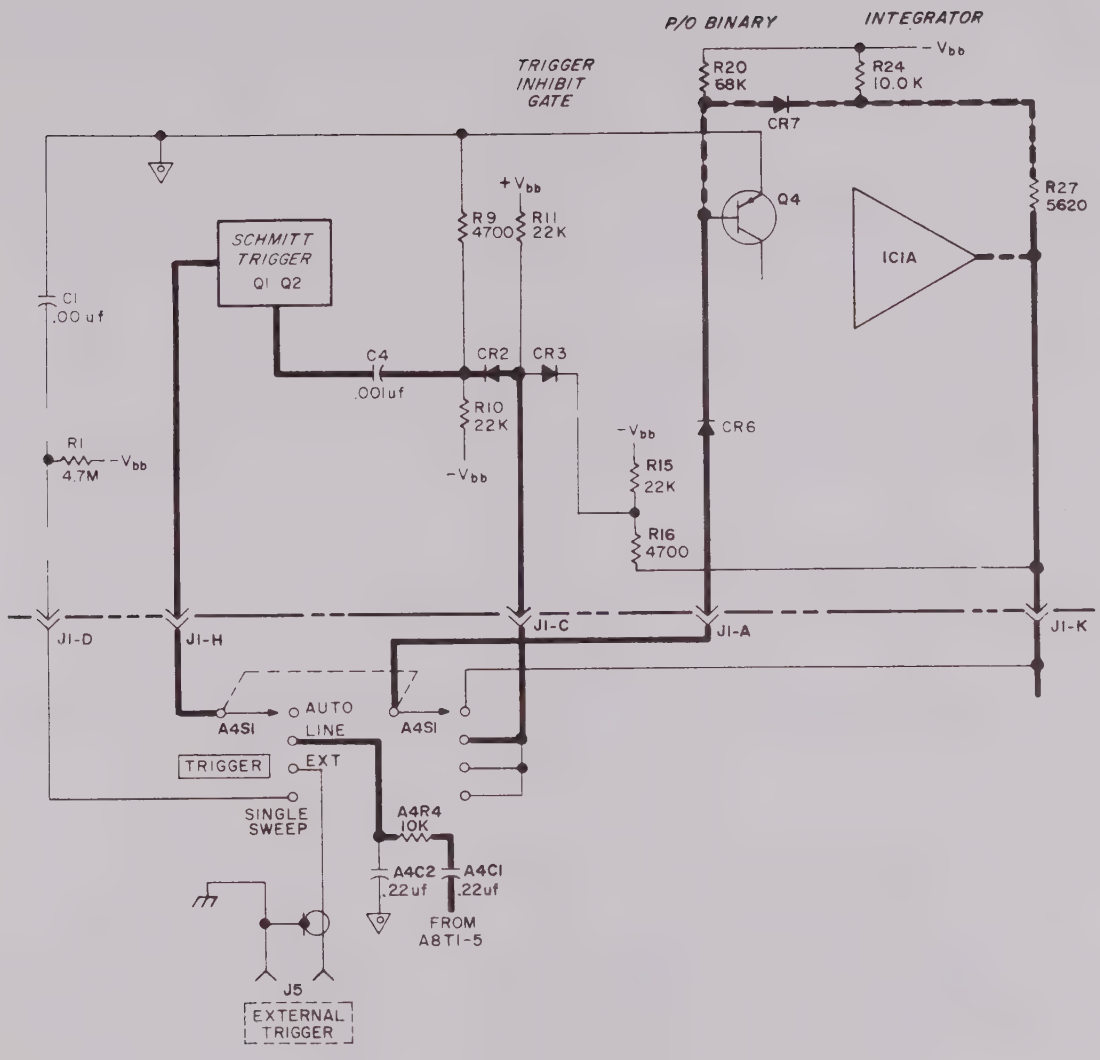


Figure 4-4. Sweep Trigger, Simplified Schematic Diagram

The negative going sawtooth is applied to pin 6 of IC1B an operational amplifier with a gain of −1 (less than 1). A dc shift voltage for centering the 12 volt peak-to-peak input waveform is also applied to pin 6 via resistor R31. The output voltage at the emitter of Q6 will never go below zero volts because of the "O" volt comparator, IC2A. When the input at pin 3 begins to go negative by only a few millivolts, the output on pin 1 immediately goes negative by several volts. This negative voltage is applied through CR13 and R37 to the input of IC1B to negate any further decrease in the input signal. Thus, the most negative output from the emitter of Q6 will never be lower than zero volts.

Similarly, the +10V comparator, IC2B, prevents the output from Q6 exceeding +10 volts. When the input at pin 5 of IC2B begins to exceed +10 volts by just a few millivolts, the output on pin 7 which is applied via CR16 and R43 to the input of IC1B goes positive by several volts. This correction signal prevents the output from ever exceeding +10 volts.

For comparison, the sawtooth input waveform and the sweep limiter output waveform are shown together at the bottom of Figure 4-3. The SWEEP OUT signal is taken from the sweep limiter output and used to provide a display sweep synchronous with the internally generated electronic sweep or manual sweep (F1-F2, M1-M-2 and SYM M1 modes) of the output frequency.

4.3.3. Sweep Trigger (Sweep and Marker Generator)

As mentioned in paragraph 4.3.1, the Binary section of the Sawtooth generator is reset on completion of a forward trace, and remains reset until set again by a sweep initiating trigger signal. The choice of trigger signal is determined by the front panel TRIGGER selector control as illustrated in Figure 4-4.

When switch A4S1 is set to EXT, a negative going input signal from the rear panel EXTERNAL TRIGGER connector is routed through A4S1 and applied to the Schmitt trigger circuit for standarization of rise time and amplitude. The positive going output after being differentiated by C4 and R9 is applied to a Trigger Inhibit Gate consisting of diodes CR2 and CR3. This gate inhibits the passage of a positive trigger until after Integrator IC1A has completed its retrace. This allows the junction of CR2 and CR3 to become positive which is routed through the right hand portion of A4S1 to the base of Q4 which sets the Binary section to the forward state.

When the TRIGGER selector is set to LINE, a sample of the 60 cycle line frequency from T1 is coupled through A4C1, A4S1 and applied to the Schmitt trigger circuit for standarization. After completion of the retrace, the next cycle of the line frequency will initiate a new sweep.

Automatic recurring sweep results when the TRIGGER selector is set to AUTO because the integrator output is then used directly as the input signal which sets the Binary section to the forward state. Upon retracing from negative to zero volts the integrator output becomes positive enough to cut off Q4 via CR7.

4.3.4 Sweep Amplifiers (Sweep and Marker Generator)

The internally generated sweep tuning waveform applied to the tuning supply regulator section of the RF Unit is modified by the sweep amplifiers in accordance with the SWEEP FUNCTION selector setting. Each position of the SWEEP FUNCTION selector interconnects the amplifiers and tuning control potentiometers in a distinct configuration.

4.3.4.1 F1-F2/M1-M2 Sweep Mode

The sweep waveform required at the input to the tuning supply regulator (located in RF Unit) in both the F1-F2 and M1-M2 modes has its start and finish voltages adjusted to conform with the sweep voltages that correspond to the frequency settings of either the M1-M2 or the F1-F2 frequency marker indicators. Figure 4-5 illustrates how this is accomplished. Voltage divider A4R11 and A4R12 divides the input sweep waveform by two and shifts the dc level. Operational amplifier IC3A doubles the result so that the combination has a gain of +1 with a dc shift. A portion of the output voltage from IC3A, as determined by the setting of the F1 (or M1) potentiometer is applied to pin 3 of IC4A. At the same time, the input is applied to pin 6 of IC3B which inverts the waveform but does not introduce a dc shift. Again, a portion of the output from IC3B is applied through potentiometer F2 (or M2) to pin 5 of IC4B. The two outputs from voltage followers IC4A and B are combined and summed by IC5A which has a gain of less than 1. Thus, the starting value and the finish value of the sweep voltage is proportional to the setting of F1(M1) and F2 (M2) potentiometers, respectively.

The direction of sweep is always from F1(M1) to F2(M2). For normal operation F1(M1) is generally set to a lower frequency than F2(M2). However, F1(M1) may be set higher in frequency than F2(M2) by a cross-over of their indicators. The output will then sweep from a higher to a lower frequency.

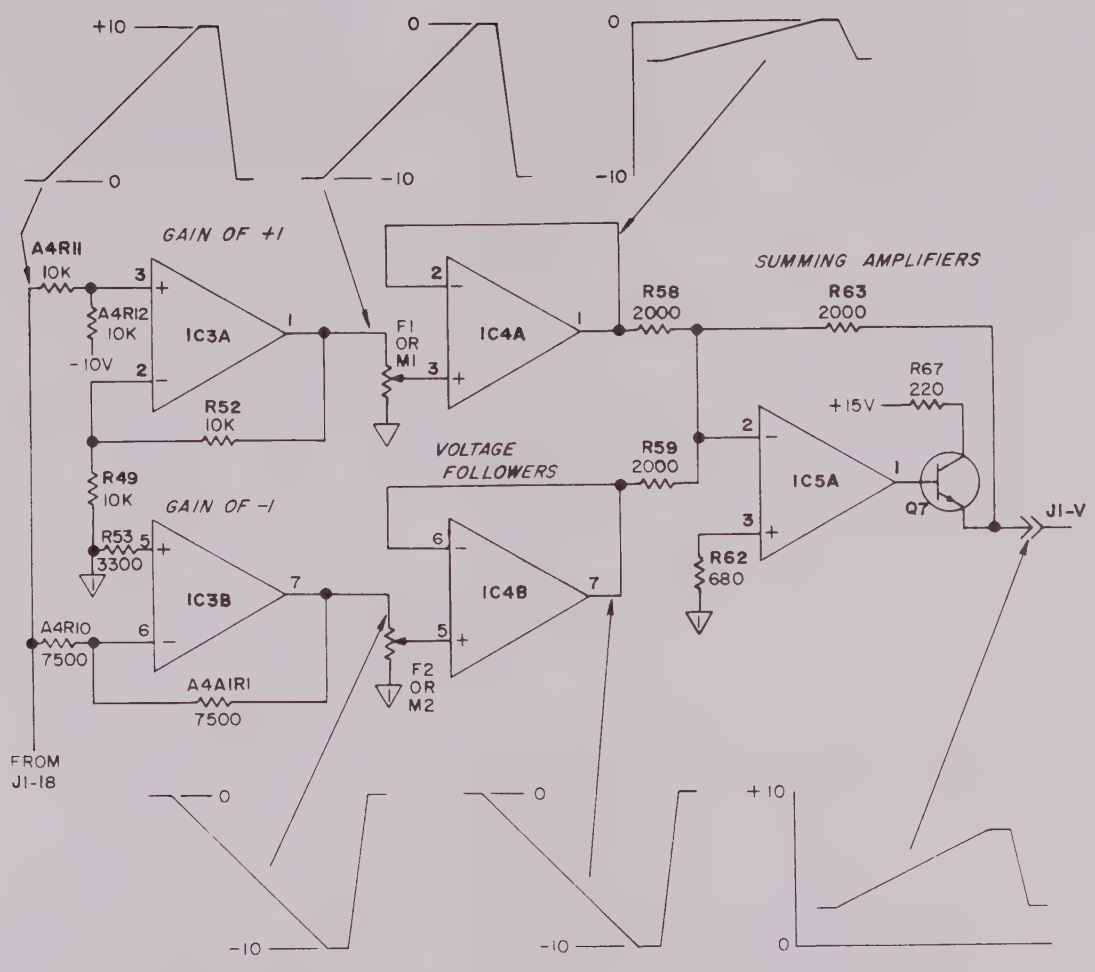


Figure 4-5. Sweep Amplifier (F1-F2/M1-M2 Modes), Simplified Schematic Diagram

4.3.4.2 Symmetrical Sweep Mode (SYM M1)

In the SYM M1 mode, the sweep amplifiers are connected as shown in Figure 4-6. The input sweep waveform is applied to pin 6 of variable gain amplifier IC3B. The amplitude of the output on pin 7 is determined by the setting of the SYMMETRICAL SWEEP WIDTH control located on the RF Unit. After passing through voltage follower IC4B, the sweep waveform is combined with the dc level established by the M1 potentiometer and applied to summing amplifier IC5A. In this way the center frequency is set by the position of the M1 control and the excursion is established by the SYMMETRICAL SWEEP WIDTH control.

4.3.4.3 External/M1 Sweep Mode (EXT/M1 Mode)

In the EXT/M1 sweep mode the sweep amplifiers are connected as shown in Figure 4-7. The external input applied to rear panel EXT SWEEP INPUT connector is fed to pin 2 of IC3A whose output

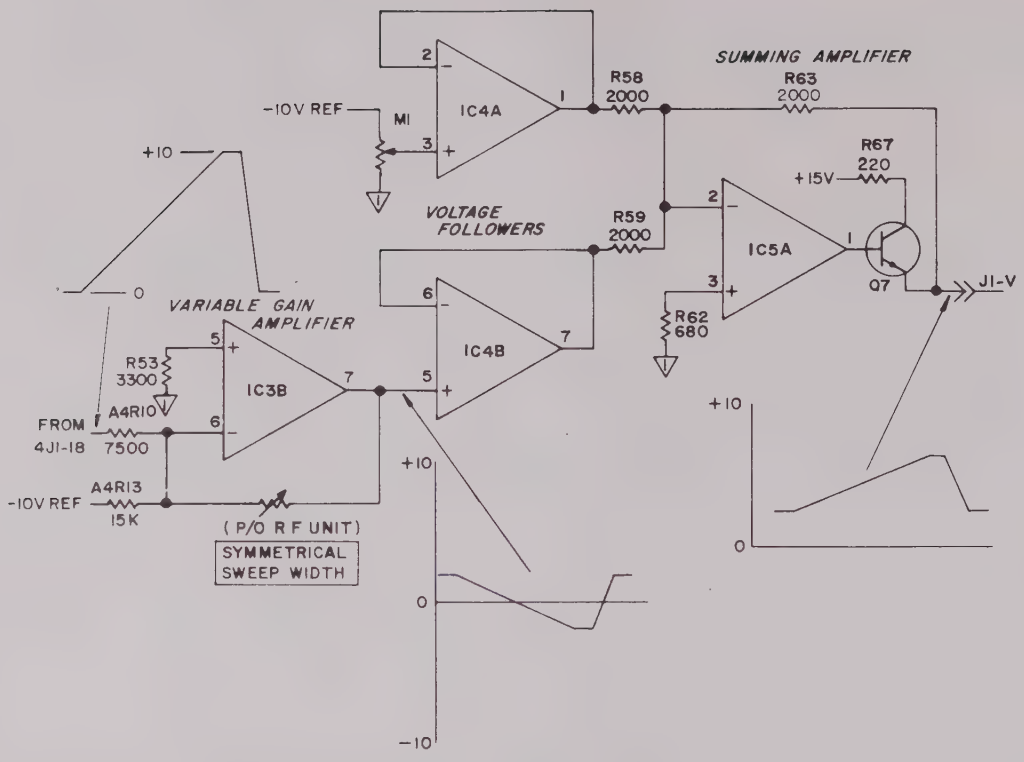


Figure 4-6. Sweep Amplifier (SYM M1 Mode) Simplified Schematic Diagram

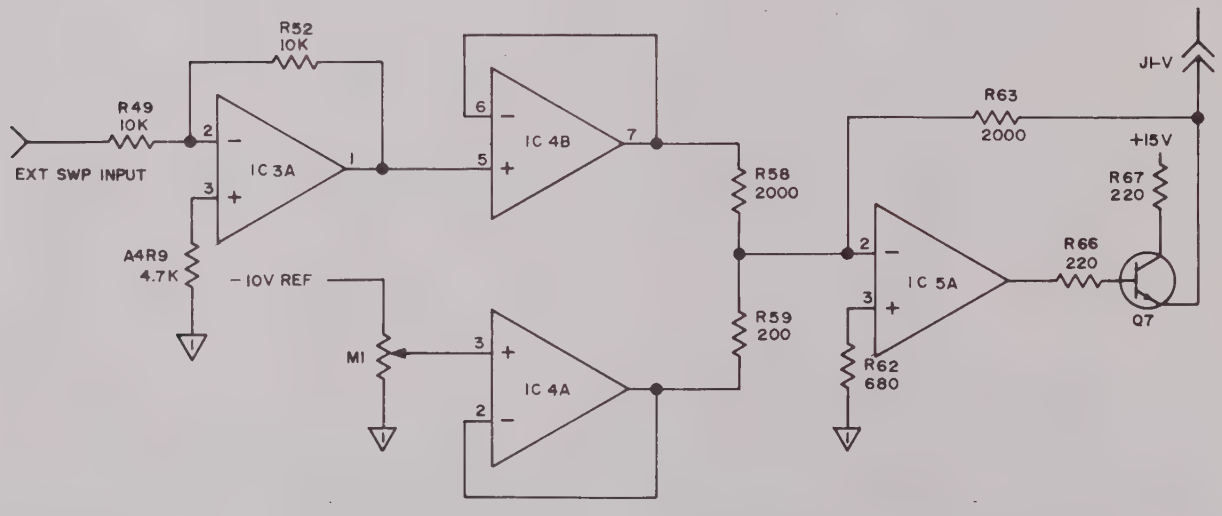


Figure 4-7. Sweep Amplifier (EXT/M1 Mode) Simplified Schematic Diagram

is used to drive voltage follower IC4B. The output from pin 7 of IC4B is combined with the dc level established by the M1 control and summed by amplifier IC5A. The tuning supply output voltage from pin 1 of summing amplifier IC5A represents the algebraic sum of the dc level from the M1 control and the external sweep input signal. The operator may vary the external sweep input voltage between 0 and +10 volts to cause a corresponding change in the output frequency. It should be noted, however, that the resulting frequency is determined by both the external input signal and the M1 control setting. The amplifier chain which duplicates the tuning supply input, applies this combined signal to the frequency marker circuit so that the M2 marker may be generated.

4.3.4.4 CW M1 Mode

As shown by Figure 4-8, adjusting the M1 control establishes a dc level which is applied to pin 3 of voltage follower IC4A. The buffered output is fed through R58 to a unity gain amplifier consisting of IC5A and Q7 whose output is used to drive the tuning supply regulator. Thus, varying M1 will cause a corresponding change in the output frequency.

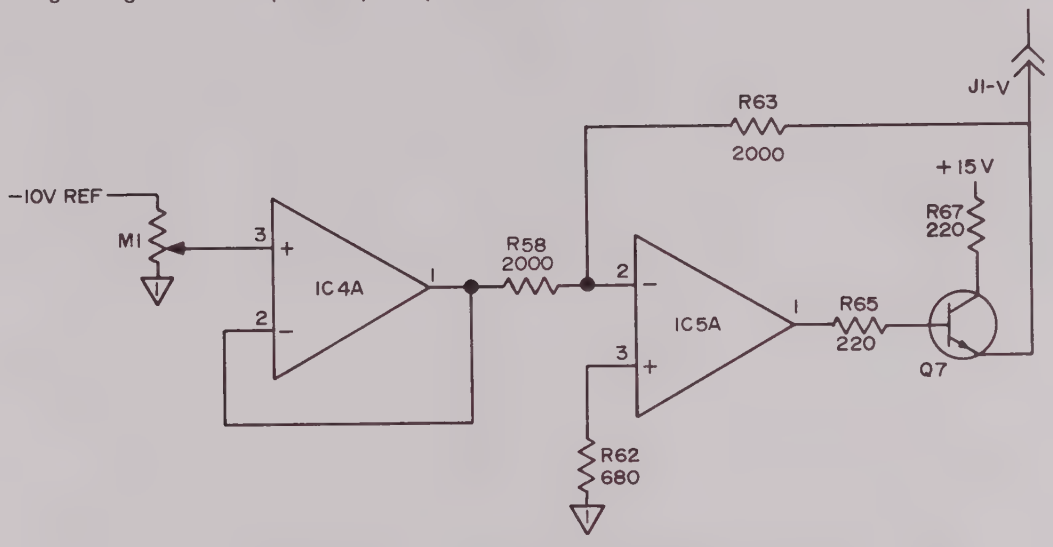


Figure 4-8. Sweep Amplifier (CW M1 Mode), Simplified Schematic Diagram

4.3.5 Proportional Output (Sweep and Marker Generator)

As shown in Figure 4-9, the proportional output signal available at the rear panel PORPORTIONAL OUTPUT connector is present in all sweep modes. With the PROPORTIONAL OUTPUT switch set to 10V/BAND the tuning voltage developed in the Mainframe is available at the connector.

The higher scale factor of 40V/OCTAVE is obtained from the feedback amplifier consisting of IC5B and Q8. The output from the sweep amplifier is applied via R68 to the non-inverting input (pin 6) of IC5B. The output on pin 7 is inverted by Q7 and applied through R11 and the 40V/OCTAVE switch to PROPORTIONAL OUTPUT connector J6. Gain is determined by the values of R7 (in the RF Unit) and R69. For a one octave RF Unit the gain is +4 which means that the proportional output will be zero at the low end and +40 volts at the high end of the octave.

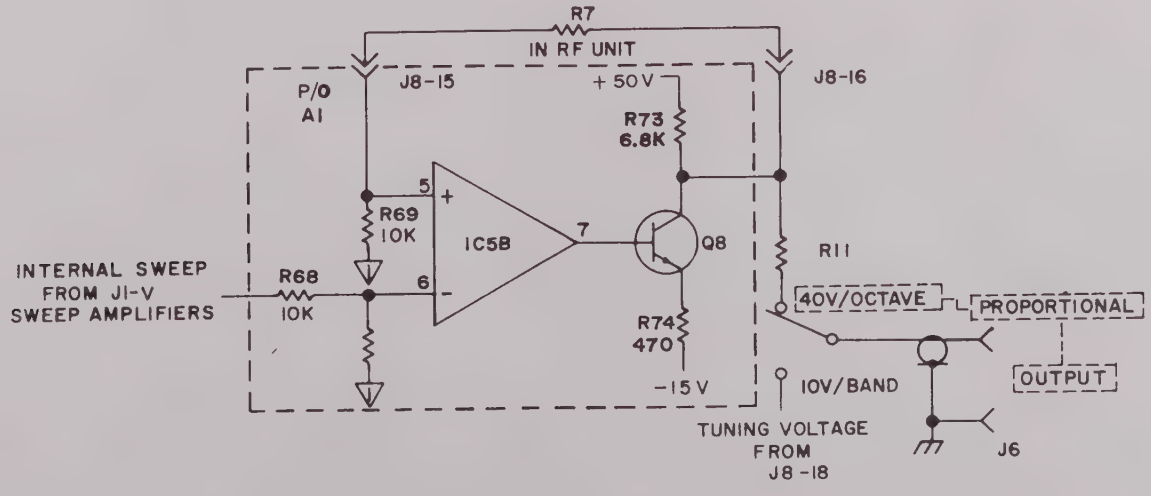


Figure 4-9. Proportional Sweep Amplifier, Simplified Schematic Diagram

4.3.6 Frequency Marker (Sweep and Marker Generator)

Each marker is generated by comparing a dc voltage with a sweeping voltage. When the sweep voltage amplitude coincides with the marker dc voltage, a marker waveform is generated. The dc voltage is obtained from a front panel marker frequency control potentiometer (M1, M2, F1 and F2) whose setting represents a voltage level corresponding to its marker position on the frequency scale.

As shown on Figure 4-10, the comparison of the dc voltage from the marker control potentiometer is accomplished via equal input resistors to a diference amplifier. Its output is a greatly amplified version of the zero crossing which results when the sweep input amplitude is equal to the marker dc voltage. The difference amplifier's direct output along with an inverted output is compared by an AND gate which selects the most positive of its inputs to form a triangle. The apex of this triangle occurs when the value of the sweep signal equals the dc level set by the marker potentiometer. The outputs of both marker channels are combined in an OR gate, attenuated by the front panel MARKER AMPLITUDE control and presented as both Video Marker Output signals and as amplitude dips if the RF MARKER is set to ON.

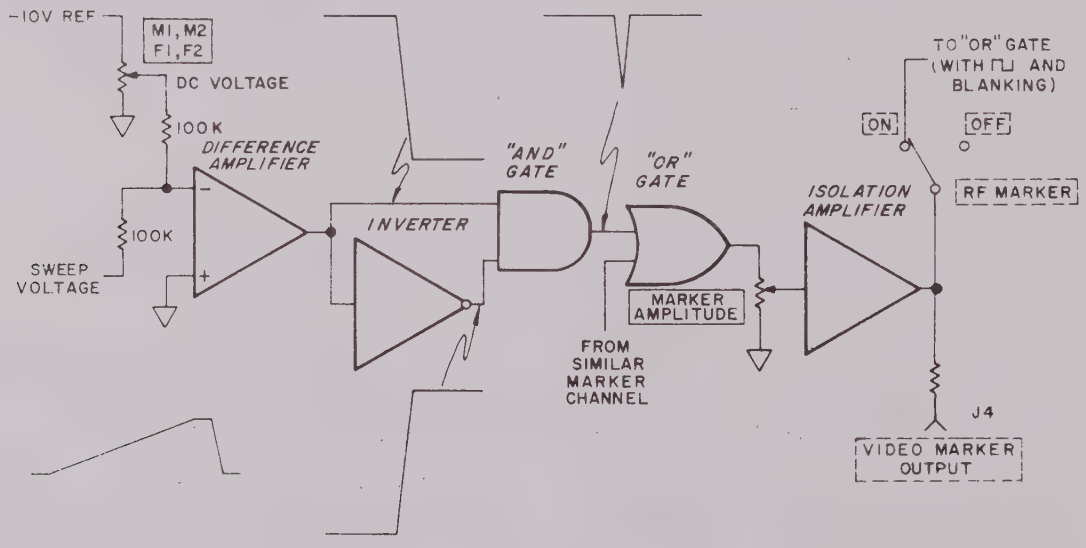


Figure 4-10. Frequency Marker Generation

4.3.7 Square Wave Generator (Sweep and Marker Generator)

Internal square wave amplitude modulation is provided by the circuit shown in Figure 4-11. Transistors Q15 and Q16 comprise an emitter coupled free running multibrator that is activated when the front panel 1KHz ⊓⊔ switch is set to ON. As Q15 goes into saturation it cuts off Q16 by capacitively driving the emitter of Q16 to a low potential while at the same time applying a high potential to its base coupling diode, CR 39. After approximately 500 microseconds, capacitor C22 discharges to the point where Q16 begins to conduct. As a result, transistor Q16 capacitively couples a reduced emitter potential to Q15 causing it to conduct less. As Q16's collector voltage decreases, the base of Q16 is driven more negative which increase the conduction of Q16 and cuts off Q15. After approximately 500 more microseconds C22 charges sufficiently and allows Q15 to begin conducting once again. Regenerative action quickly saturates Q15 which cuts off Q16 and the cycle continues.

The square wave output is combined with a blanking signal from the Sawtooth Oscillator and with RF Markers and used to amplitude the RF output via the RF Units' Leveler section. Frequency of the 1 KHz generator may be varied by using the front panel 1 KHz ⊓⊔ screwdriver adjustment.

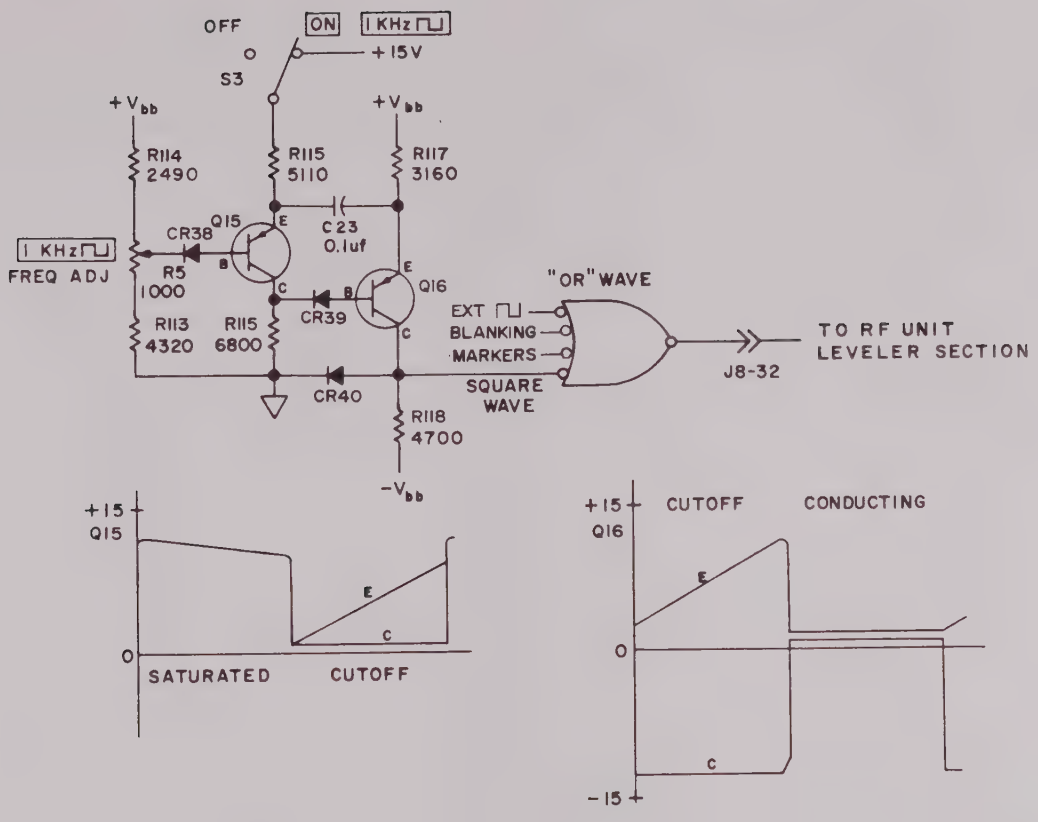


Figure 4-11. 1KHz Square Wave Generator

4.3.8 Power Supplies

When primary power is applied to the Model 430A the PUSH ON switch becomes illuminated to verify operation. As shown in Figure 6-2 , the +50 volt, Bias, Varactor and YIG supplies have their rectifiers and filters located on the A4 Assembly. The ±15 volt and +5 volt rectifiers and filters along with their respective regulators are located on the A2 Assembly. Also located on the A2 Assembly is the +10 volt supply which is referenced to the +15 volt source.

4.3.8.1 ±15 and −10 Volt Supplies

Each regulated supply consists of a dc source, a series control transistor and an amplifier which compares the regulated output voltage with a zener reference voltage. As indicated in Figure 4-12, the +15 volt supply uses zener diode A2CR2 to establish the reference voltage. The +15 volt supply in turn serves as the reference voltage for both the −10 volt and −15 volt supplies. The +15 volt supply is also used as the source voltage for the −10 volt supply. An unregulated +50 volts is derived from the same T1 secondary winding used for the ±15 volt supplies. Its rectifier and filter are located on the A4 assembly.

4.3.8.2 +5 Volt Supply

The +5 volt supply receives its input voltage from a separate winding on T1. The unregulated 5 volts is rectified by A2CR6 and filtered by A2C25 before being applied to reference amplifier A2IC2B. Transistor A2Q12 and its associated circuitry is used to provide voltage protection for the +5 volt supply.

4.3.8.3 Bias Supply and Tuning Supply

The Bias Supply and Tuning Supply, respectively, supply the bias voltage and the unregulated DC for the YIG tuned RF oscillator located in the RF Unit. Operation of the RF oscillator is covered in the RF Unit Instruction Manual.

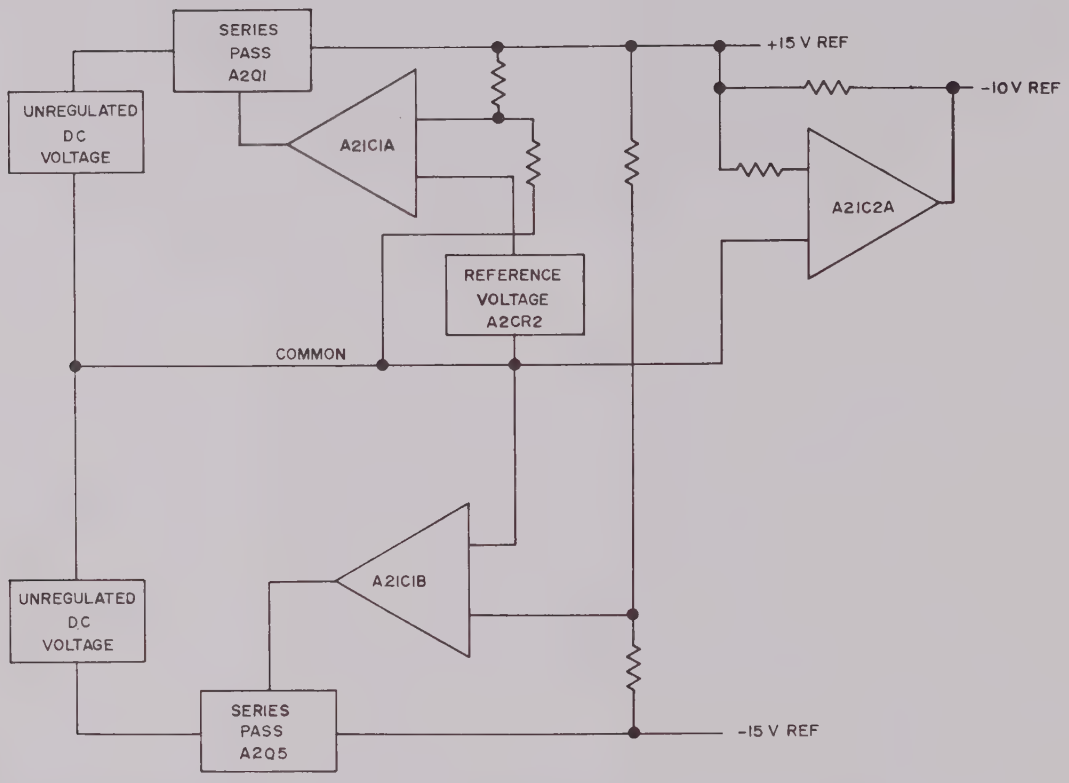


Figure 4-12. ±15 Volt and −10 Volt Power Supply Block Diagram

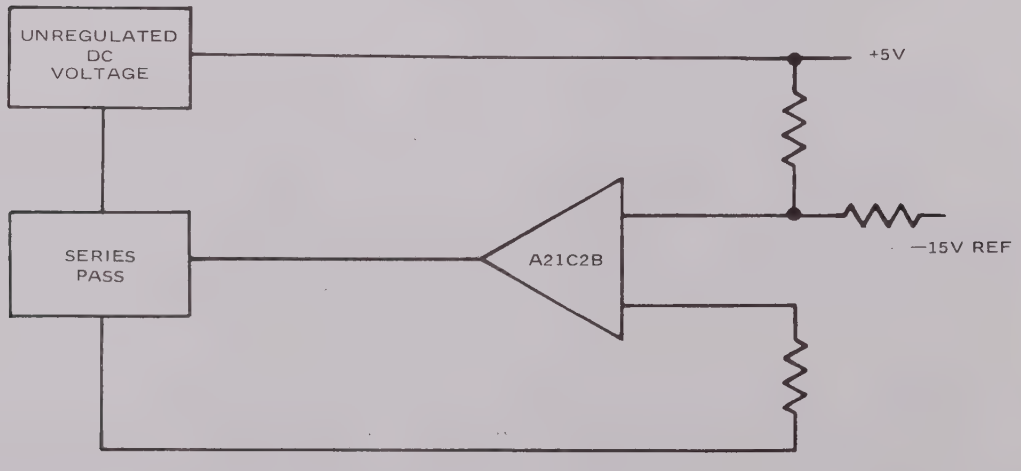


Figure 4-13. ±5 Volt Power Supply Block Diagram

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides the information required to maintain and service the Model 430A Sweep Oscillator (Mainframe) and contains a list of the required test equipment, a performance check, calibration and alignment procedures, and a replaceable parts list.

5.2 REQUIRED TEST EQUIPMENT

Test equipment other than those listed in Table 5-1 may be used if their specifications equal or exceed the required characteristics. (use recently calibrated test equipment.) The equipment required to perform the calibration is listed in Table 5-2.

5.3 PERFORMANCE TESTS

The following performance tests are performed to verify whether the Model 430A is operating within its specifications as listed in Table 1-1. The tests should be used as part of the incoming quality control inspection, as a periodic operational check or after maintenance and service has been performed.

NOTE

An RF unit must be installed in the Model 430A Mainframe before starting the following performance tests.

5.3.1 Frequency Accuracy

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as follows:

Front Panel

TRIGGER	Line
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
F1	Low Limit
F2	High Limit
1 KHz ⊓⊔	Off (down)
PUSH ON	Depress and Release

Rear Panel

SWEEP RESPONSE TIME	AUTO
RF MARKERS	ON

RF Unit	
RF	ON
If the RF Unit has Option-1 (internal leveling) set:	
LEVELER MODE	INT (depress)
RF LEVEL	Adjust ccw until leveling is obtained across the entire band.
If the RF Unit does not have Option-1 set:	
LEVELER MODE	OFF (depress)
RF LEVEL	Fully cw

c. Set the M1 and M2 indicators at the frequencies to be checked and adjust the MARKER AMPLITUDE as desired.

d. Tune the frequency meter to make its dip coincident with each marker dip.

e. Observe that the frequency indicator and the frequency meter indications fall within frequency accuracy limits of the RF Unit specifications.

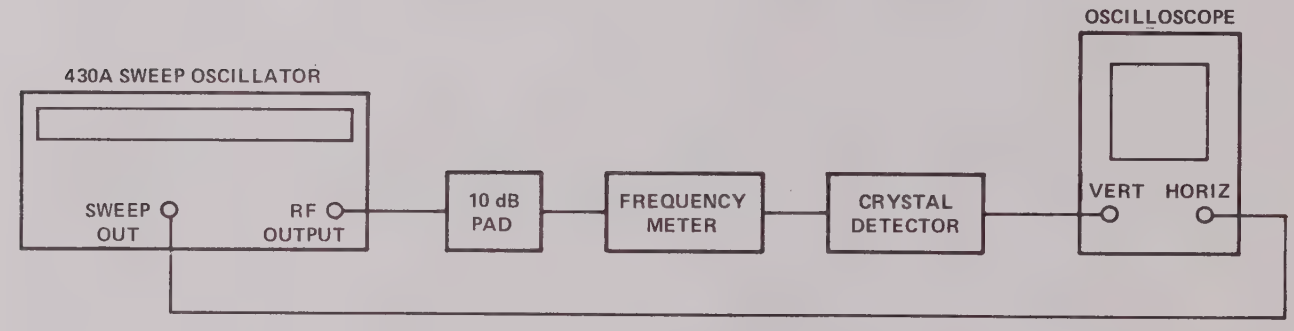


Figure 5-1. Frequency Accuracy Measurement Test Setup.

5.3.2 Power Output (Unleveled)

a. Connect the power meter to the RF OUTPUT connector through a 10 dB pad. Do not use intervening cabling.

b. Set Model 430A controls as follows:

SWEEP FUNCTION	CW M1
1 KHz ⊓⊔	Off (down)
RF LEVEL	Fully cw
LEVELER MODE	OFF

c. Adjust the M1 control across the band and note the minimum output power level indicated on the power meter.

TABLE 5-1. REQUIRED TEST EQUIPMENT FOR PERFORMANCE TESTS		
Title	**Requirements**	**Suggested Manufacturer and Model No.**
Variable Transformer	at least 105 to 125 VAC 1 AMP	Superior Electric Co. 3PE116
AC Voltmeter	at least 105 - 125 VAC ±1% 48 - 420 Hz	Weston 433
Oscilloscope	Vertical: DC to at least 300 kHz	Tektronix 561A with 2A63 Differential Amp 1 and 2B67 Time Base
Frequency Meter, Reaction Type		
200 - 500 MHz	±0.1% accuracy	Narda 804
500 - 1000 MHz	±0.1% accuracy	Narda 805
1 - 2 GHz	±0.1% accuracy	General Microwave N607
1 - 4 GHz	±0.1% accuracy	General Microwave N604
4 - 8.2 GHz	±0.1% accuracy	General Microwave N608A
8.2 - 12.4 GHz	±0.1% accuracy	HP X532B with two coaxial to waveguide adaptors
12.4 - 18 GHz	±0.1% accuracy	HP P532A with two coaxial to waveguide adaptors
10 dB Attenuator Pad	Calibrated within ±0.1 dB VSWR 1.3 max	Weinschel Model 2 or 2A
RF Power Meter with Thermistor Mount		
0.2 to 8.2 GHz	±0.3 dB	HP 432A with HP 478A
8.2 to 12.4 GHz		HP X486A with coaxial to waveguide adaptor
12.4 to 18 GHz		HP P486A with coaxial to waveguide adaptor
Directional Coupler	10 dB coupling factor	
30 to 1000 MHz	20 dB directivity	Anzac DCG10
500 to 1000 MHz		Weinschel Model 1540
1 - 2 GHz		Weinschel Model 1541
2 - 4 GHz		Weinschel Model 1542
4 - 8 GHz		Weinschel Model 1543
8 - 12.4 GHz		Weinschel Model 1544
12.4 - 18 GHz		
Waveform Generator	±10 Volt, less than 1 microsecond rise time 10 to 1000 Hz	Exact Electronics 100
Ohmmeter	DC continuity	Simpson 261

TABLE 5-2. REQUIRED TEST EQUIPMENT FOR CALIBRATION PROCEDURES		
Title	**Requirements**	**Suggested Manufacturer and Model No.**
Precision DC Voltmeter	±0.1% accuracy, 400 K minimum resistance 1 millivolt sensitivity	Fluke 891A

NOTE

Power meter and pad calibration factors must be taken into account when checking the power output level.

d. The minimum power indication should be equal to or higher than the minimum power output level (mW) as specified in the RF Unit specifications*.

5.3.3 Power Variation (Leveled)

5.3.3.1 Internal Leveling

a. Connect a power meter to the RF OUTPUT connector through a 10 dB pad. Do not use intervening cabling.

b. Set Model 430A controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1-F2
SWEEP TIME	MAN
F1	Low end of band
F2	High end of band
1 KHz ⊓⊔	Off (down)
LEVELER MODE	INT

c. Simultaneously adjust the RF LEVEL control ccw just enough to keep the UNLEVELED indicator extinguished while rotating the SWEEP TIME (SEC) VARIABLE control through its entire range and note maximum and minimum power levels (dB) as indicated on the power meter.

d. The total power variation observed in step c. should be less than the total variation specified for the RF Unit. The pad calibration value must be taken into account.

5.3.3.2 External Leveling

a. Connect equipment as shown in Figure 5-2.

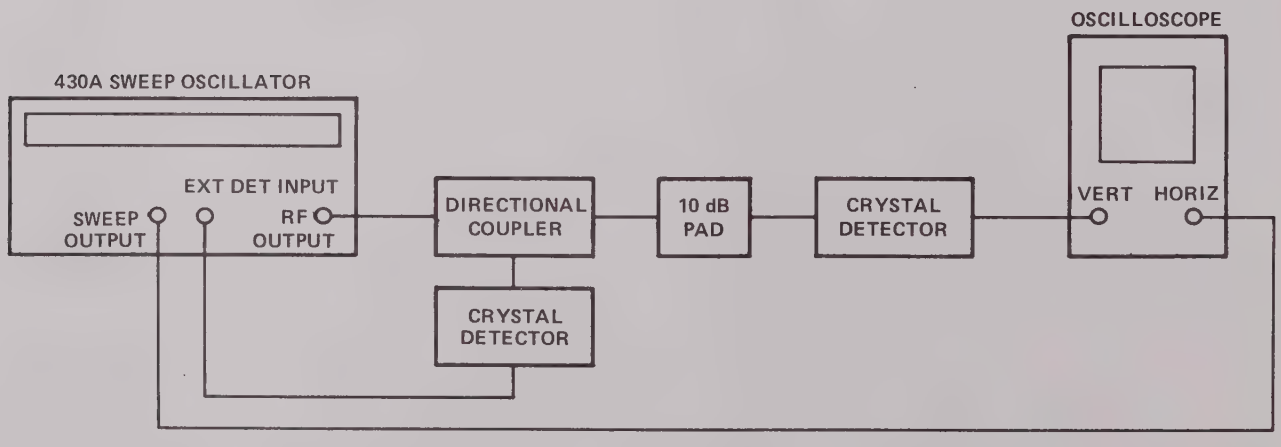


Figure 5-2. External Leveling Measurement Test Setup.

*RF Units with Option 1 (internal leveling) have a slightly lower minimum output level than those units which do not include the option.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.01
F1	Low end of band
F2	High end of band
1 KHz ⊓⊔	Off (down)
SWEEP RESPONSE TIME	AUTO
LEVELER MODE	XTAL EXT*

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains extinguished.

d. Replace the oscilloscope and crystal detector with an RF Power Meter as shown in Figure 5-3.

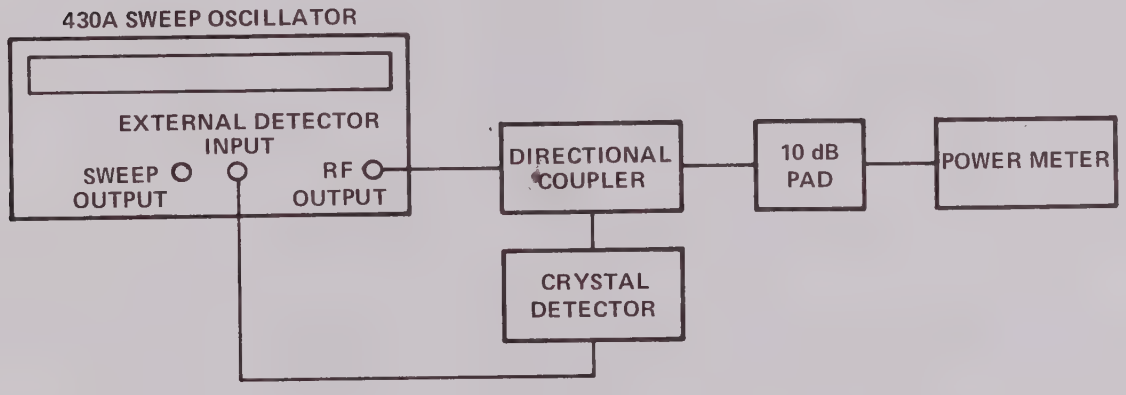


Figure 5-3. External Leveling Measurement Test Setup (2).

e. Set the SWEEP TIME control to MAN.

f. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

g. The total power variation observed in step f. should be less than the total variation specified for the RF Unit. The effect of the external crystal detector in addition to the 10 dB pad must be taken into account.

5.3.3.3 Power Meter Leveling

a. Connect equipment as shown in Figure 5-2 with the following exceptions: substitute a power meter (HP Model 432A recommended) for the crystal detector and connect the DC output (recorder output) to the EXT DET INPUT on the Model 430A.

b. Set the Model 430A controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1-F2
SWEEP TIME	MAN

*XTAL/PWR MTR slide switch is located on top left hand side of RF Unit, near the front panel.

F1	Low end of band
F2	High end of band
1 KHz ⊓⊔	Off (down)
LEVELER MODE	EXT with XTAL/PWR MTR slide switch set to PWR MTR

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains extinguished.

d. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

e. Maximum power variation should be less than ±0.1 dB.

5.3.4 Sweep Trigger

5.3.4.1 Automatic

a. Connect equipment as shown in Figure 5-1 except that the frequency meter may be omitted and the 10 dB pad is connected directly to the crystal detector.

b. Set Model 430A controls as follows:

TRIGGER	AUTO
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1

c. Observe that the sweep is present on the oscilloscope and that the SWEEP ON indicator is illuminated during forward trace.

5.3.4.2 Line Trigger

a. Repeat 5.3.4.1 except set TRIGGER selector to LINE position.

5.3.4.3 Single Sweep

a. Repeat 5.3.4.1 except set TRIGGER selector to SINGLE SWEEP position.

b. The TRIGGER selector is spring loaded and returns to the EXT position when released. The sweep should occur once for each time the TRIGGER selector is set to SINGLE SWEEP.

NOTE

Do not apply external trigger input signals when using the single sweep mode.

5.3.4.4 External Trigger

a. Repeat 5.3.4.1 except set TRIGGER selector to EXT position.

b. Apply any convenient trigger waveform (sine, square, or ramp) to the EXT SWP INPUT located on the rear panel. Duration of the input pulse must be a minimum of 1 microsecond

with any repetition rate between 1 and 100 Hz. Increase amplitude of the input level until a reliable sweep generation is established.

NOTE

Amplitude of the external trigger input signal should not exceed −10 volts.

5.3.5 Internal Square Wave

5.3.5.1 Unleveled

a. Connect equipment as shown in Figure 5-1 except that the frequency meter may be omitted and the 10 dB pad is connected directly to the crystal detector. Also, remove the cable between the SWEEP OUTPUT on the Model 430A and the horizontal input on the oscilloscope.

NOTE

The output of the crystal detector (connected to the oscilloscope) should be shunted by a resistor of approximately 600 ohms to reduce the time constant of the crystal detector.

b. Set the Model 430A controls as follows:

1 KHz ⊓⊔	ON
RF LEVEL	Fully ccw
LEVELER MODE	OFF

c. Using the oscilloscope time base, measure square wave rise time, fall time and period. Both rise and fall times should be 10 microseconds maximum. The period should be adjustable from less than 950 to more than 1050 microseconds

5.3.5.2 Leveled

a. If the RF Unit has Option 1, use the same equipment setup as used in 5.3.5.1 and set the Model 430A controls as follows:

LEVELER MODE	INT
1 KHz ⊓⊔	ON
RF LEVEL	Rotate ccw until UNLEVELED indicator just goes out.

b. If the RF Unit does not have Option-1, set the controls as described in step a. except that the LEVELER MODE must be set to XTAL.

c. Connect equipment as shown in Figure 5-2.

d. Using the oscilloscope time base, measure both rise and fall time and symmetry. Rise and fall time should each be 10 microseconds maximum; symmetry within 60:40.

5.3.6 External AM

a. Connect equipment as shown in Figure 5-2.

b. Set Model 430A controls as follows:

1 KHz ⊓⊔	Off (down)
RF LEVEL	Mid range (approximate)
LEVELER MODE	OFF

c. Connect the output from a square wave generator to the rear panel AM Input. Adjust amplitude so that a further increase does not increase the RF amplitude. A positive voltage increases the output power if the RF LEVEL control is not fully counterclockwise, while a negative voltage decreases the output power.

d. Rise and fall time should not exceed 1 microsecond; maximum amplitude into the AM Input connector should not exceed either +10 or −10 volts.

e. Set Model 430A controls as follows:

LEVELER MODE	INT
1 KHz ⊓⊔	Off (down)
RF LEVEL	Fully ccw

f. Repeat step c. and check that rise and fall time does not exceed 2 microseconds.

5.3.7 Symmetrical Sweep Width Accuracy

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.1
M1	Center of band
RF LEVEL	Fully cw
LEVELER MODE	OFF
SWEEP RESPONSE TIME	AUTO

c. At each setting of the SYMMETRICAL SWEEP WIDTH control to be checked (depending on RF Unit) tune the frequency meter to both the high and the low end of the frequency range being swept and note the two different frequency readings.

d. The difference between the two frequency meter readings and the corresponding frequency limits of the calibrated settings of the SYMMETRICAL SWEEP WIDTH control should be within ±3% for YIG tuned RF Units and ±10% for Varactor tuned RF Units.

5.3.8 Residual FM

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as specified in 5.3.7 step b. except for the RF LEVEL control which is rotated fully counterclockwise.

c. Calibrate the frequency meter as a function discriminator as follows: Tune the frequency meter so that its dip is centered in the oscilloscope display as shown in Figure 5-4. Place a straight edge on the display and measure the maximum slope of the frequency meter dip. Divide the vertical measurement to obtain the discriminator constant in millivolts/KHz.

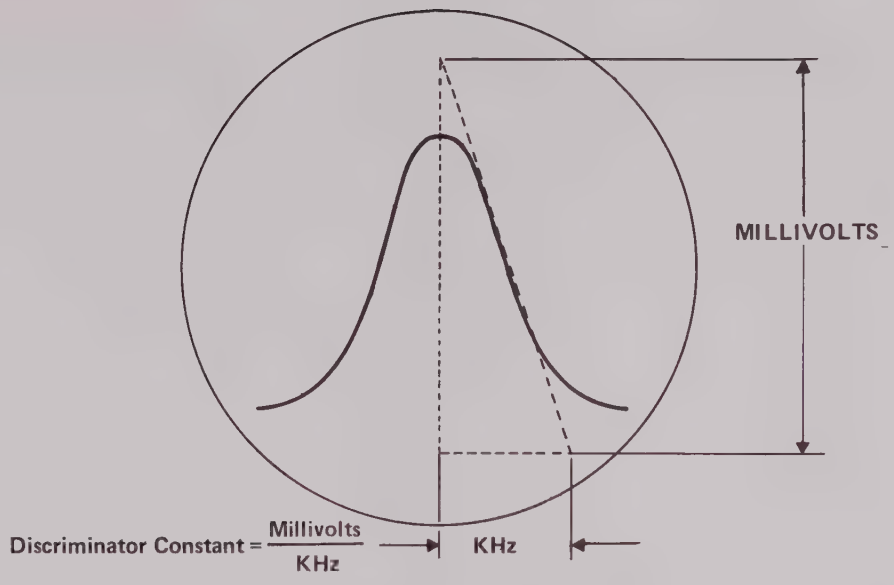


Figure 5-4. Slope Discriminator Display.

d. Set SWEEP FUNCTION switch to SYM M1.

e. Set SWEEP TIME (SEC) switch to MAN and rotate the VARIABLE (vernier) control fully counterclockwise.

f. Rotate SYMMETRICAL SWEEP WIDTH control (on RF Unit) fully counterclockwise for narrowest sweep width.

g. Increase the oscilloscope vertical sensitivity and tune the frequency meter for maximum peak-to-peak vertical amplitude. The oscilloscope time base should be used. Record the peak-to-peak amplitude.

h. Divide the peak-to-peak amplitude figure by the discriminator constant to obtain KHz peak-to-peak. Then divide by 2 to obtain peak residual FM. This should not exceed the specification for the RF Unit being used.

NOTE

To ensure that the auto bandwidth circuitry is functioning properly, place the SWEEP RESPONSE TIME slide switch (on rear panel) to FAST. The residual FM should increase considerably. Then set the switch back to AUTO. Within a few seconds, the residual FM should decrease to its minimum value indicating that the bandwidth has been reduced.

5.3.9 Blanking Output

a. Connect the rear panel BLANKING OUTPUT to the oscilloscope vertical input.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	0.1

c. Output should be at least −5 volts (coincident with sweep retrace).

5.3.10. Marker Video Output

a. Connect the rear panel MARKER OUTPUT to the oscilloscope vertical input.

b. Set Model 430A controls as follows:

MARKER AMPLITUDE	Fully cw
TRIGGER	LINE
SWEEP FUNCTION	F1-F2
F1	Low end of band
F2	High end of band
M1 and M2	Within band
SWEEP TIME (SEC)	.1

c. Output should be at least −5 volts.

5.3.11 Pen Lift

a. Connect an ohmmeter to the rear panel PEN LIFT TERMINALS.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	10

c. Ohmmeter should indicate continuity during forward trace; open during retrace.

5.3.12 Proportional Sweep Amplitude

a. Connect the PROPORTIONAL OUTPUT to the oscilloscope vertical input.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	0.1
F1	Lower limit
F2	Upper limit
PROPORTIONAL	10V/BAND

c. The PROPORTIONAL OUTPUT voltage should start at +0.25 (±0.25) volts and finish at +9.75 (±0.25) volts.

d. Set the rear panel PROPORTIONAL switch to 40 V/OCTAVE.

e. The PROPORTIONAL OUTPUT voltage should now start at +1 (±1) volt and finish at +40 (±3) volts.

5.4 CALIBRATION PROCEDURES

5.4.1 Reference Power Supplies

NOTE

The following measurements of power supply outputs should be made with a precision DC Voltmeter.

a. Remove the RF Unit from the Model 430A.

b. Connect a jumper between A1TP2 and chassis ground.

c. Connect the precision voltmeter to A2TP5 (negative), −10 volt supply, and to A2TP2 (positive), its return.

d. Adjust trimmer A2R10 to obtain a reading of −10 (±0.010) volts on the voltmeter.

e. Connect the precision voltmeter to A2TP1 (negative) and A2TP2 (positive) and observe that the −15 volt regulated supply output measures −15 (±0.020) volts.

f. Connect the precision voltmeter to A2TP3 (positive) and A2TP2 (negative) and observe that the +15 volt regulated supply output measures +15 (±0.020) volts.

g. Connect the precision voltmeter to A2TP4 (positive) and A2TP6 (negative) and observe that the +5 volt regulated supply output measures +5 (±0.3) volts.

5.4.2 Dial Mechanism Calibration

a. Set indicators M1, M2, F1 and F2 at the nominal low end of the frequency scale as illustrated in Figure 5-5A.

b. Set SWEEP FUNCTION selector to F1-F2.

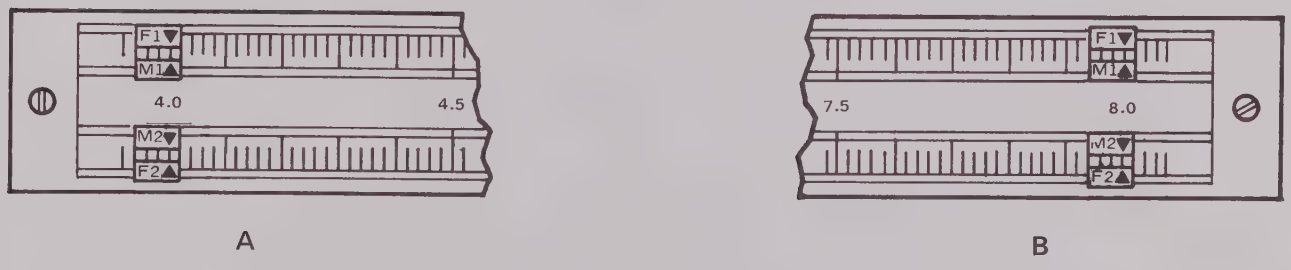


Figure 5-5. Dial Mechanism Calibration Settings.

NOTE

Use a precision voltmeter for the following measurements.

c. Connect the voltmeter to A5TP1 (positive) and A5TP5 (negative). See Figure 5-6 for test point and adjustment locations. Adjust A5R6 to obtain a voltmeter indication of 0.328 (±0.005) volts.

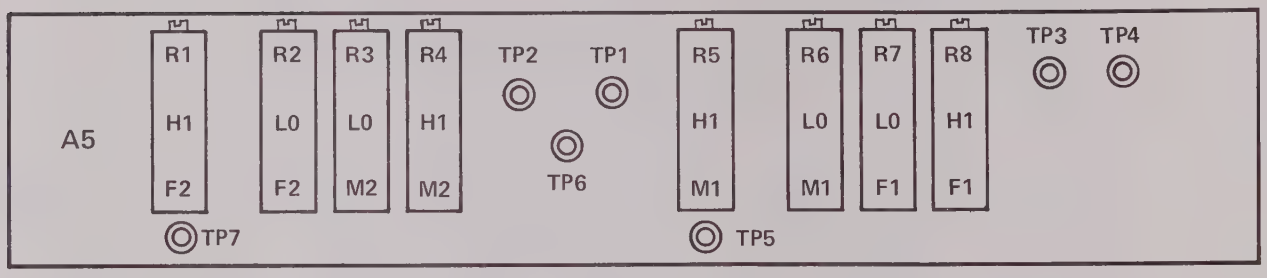


Figure 5-6. Test Point and Adjustment Locations, Assembly A5.

d. Connect the voltmeter to A5TP1 (positive) and A5TP6 (negative). Adjust A5R3 to obtain a voltmeter indication of 0.328 (±0.005) volts.

e. Set the SWEEP FUNCTION selector to M1-M2.

f. Connect the voltmeter to A5TP1 (positive) and A5TP4 (negative). Adjust A5R7 to obtain a voltmeter indication of 0.328 (±0.005) volts.

g. Connect the voltmeter to A5TP1 (positive) and A5TP7 (negative). Adjust A5R2 to obtain a voltmeter indication of 0.328 (±0.005) volts.

h. Set indicators M1, M2, F1 and F2 at the nominal high end of the frequency scale as illustrated in Figure 5-5B.

i. Connect the voltmeter to A5TP3 (negative) and A5TP4 (positive). Adjust A5R8 to obtain a voltmeter indication of 0.328 (±0.005) volts.

j. Connect the voltmeter to A5TP3 (negative) and A5TP7 (positive). Adjust A5R1 to obtain a voltmeter indication of 0.328 (±0.005) volts.

k. Set the SWEEP FUNCTION selector to F1-F2.

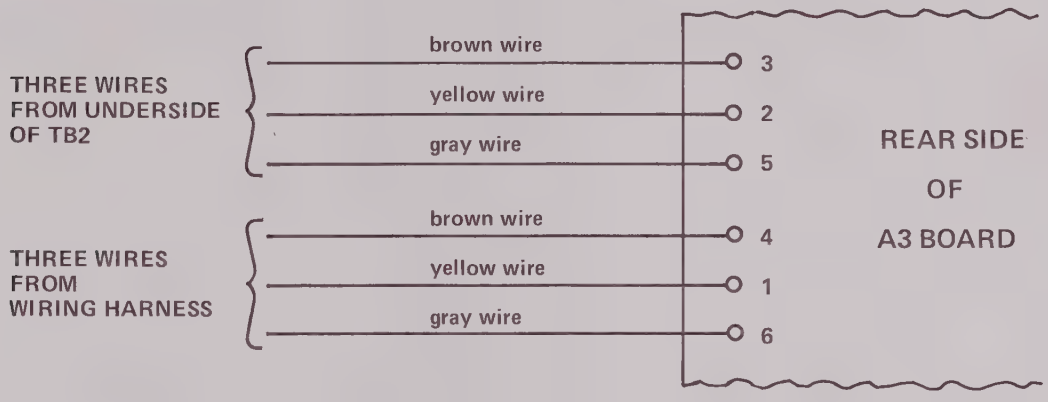
l. Connect the voltmeter to A5TP2 (negative) and A5TP5 (positive). Adjust A5R5 to obtain a voltmeter indication of 0.328 (±0.005) volts.

m. Connect the voltmeter to A5TP2 (negative) and A5TP6 (positive). Adjust A5R4 to obtain a voltmeter indication of 0.328 (±0.005) volts.

5.4.3 Remote Digital Frequency Programming (Option 01)

a. Insure that a Remote Digital Frequency Programming Board (A3) is installed in Mainframe jack J3 (See Figure 6-1) and perform the following wiring changes before proceeding to step b.

After installing an A3 board, remove the six quick disconnect wires from TB2 and reconnect them to quick disconnect pins 1 thru 6 on the rear of the A3 board. Three of these wires come from the underside of TB2 and three come from a wiring harness. Connect these wires to the six quick disconnect pins on the A3 board as indicated in the following sketch:



Remove the jumper from between terminals 1 and 2 on TB1 (Rear Panel of Model 430 A). This is marked: "FOR OPTION 01 REMOVE JUMPER".

b. Set Model 430 A controls as follows:

TRIGGER	EXT
MARKER AMPLITUDE	Fully cw
SWEEP FUNCTION	EXT/M1
SWEEP TIME (sec)	MAN
1 KHz ⊔⊓	OFF

c. Apply decimal 000 (BCD 0000-0000-0000), logic level "0's" to pins as indicated on the 36 pin REMOTE PROGRAMMING INPUT CONNECTOR (J12) located on the Model 430 A rear panel.

J12 Pins	31	30	32	34		27	26	28	29		23	22	24	25
BCD Bits	D3	C3	B3	A3		D2	C2	B2	A2		D1	C1	B1	A1

most significant BCD digit — least significant BCD digit

d. Enter the BCD input into the latches by applying a logic "0" (Ground) to J12, pin 21 (Remote Enable) and a logic "1" (+5 volts or an open circuit) to J12, pin 20 (Strobe).

e. Connect a precision voltmeter between A3TP1 (A/D converter output) and A3TP2 (Analog Ground) and adjust A3R2 to obtain an indication of 0.000 (±0.003) volts. (Looking at the component side of the A3 board, A3TP1 is a quick disconnect pin located to the immediate left of A3R1)

f. Apply decimal 999 (BCD 1001-1001-1001) to J12 connector pins (refer to step c.) and adjust A3R1 to obtain a voltmeter indication of 9.990 (±0.003) volts.

g. Apply decimal 000 (BCD 0000-0000-000) to J12 connector pins. Connect the voltmeter leads between A1TP5 (See Figure 6-1) and A3TP2 and adjust A3R3 to obtain an indication of 0.000 (±0.003) volts.

h. Calibration of the A3 board is now completed.

l. Connect the voltmeter to A5TP2 (negative) and A5TP5 (positive). Adjust A5R5 to obtain a voltmeter indication of 0.328 (±0.005) volts.

m. Connect the voltmeter to A5TP2 (negative) and A5TP6 (positive). Adjust A5R4 to obtain a voltmeter indication of 0.328 (±0.005) volts.

5.5 ALIGNMENT PROCEDURES

5.5.1 Waveform Generator Alignment

a. Connect a temporary jumper from A1TP2 to A1TP12.

b. Set Model 430A controls as follows:

TRIGGER	EXT
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
F1	Low end of band

c. Measure the voltage between A1TP11 and A1TP12 (return). Adjust AIR51 to obtain a reading of −10 (±0.002) volts.

d. Remove the jumper installed in step a.

e. Measure the voltage between A1TP10 and A1TP12 (return). Adjust AIR55 to obtain a reading of 0 (±0.002) volts.

f. Connect temporary jumpers from: A1TP12 to A1TP13 and from A1TP12 to TP14.

g. Measure the voltage between A1TP15 and A1TP12 (return). Adjust R61 to obtain a reading of 0 (±0.002) volts.

h. Remove jumpers installed in step f.

5.5.2 Marker Alignment

a. Connect the SWEEP OUT to the oscilloscope horizontal input.

b. Connect the rear panel MARKER VIDEO OUTPUT to the oscilloscope vertical input.

c. Set Model 430A controls as follows:

MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
TRIGGER	AUTO
M1	Exactly mid-band
F2	One scale division higher than M1 setting
F1	One scale division lower than M1 setting
M2	Fully cw

d. Adjust A1R94 so that the M1 marker appears at the center of the oscilloscope display.

e. Rotate M1 fully clockwise and position the M2 marker to exactly mid-band.

f. Adjust A1R92 so that the M2 marker appears at the center of the oscilloscope display.

g. Using the calibrated oscilloscope display, check that the amplitude of both markers is a minimum of −5 volts.

5.5.3 Internal Square Wave Alignment

a. Set Model 430A controls as follows:

SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
1 KHz	ON

b. Connect the oscilloscope vertical input to A1TP16 and chassis ground.

c. Using the oscilloscope time base, measure the rise and fall time of the 1 KHz square wave. Both rise and fall time should not exceed 10 microseconds.

d. Front panel screwdriver adjustment R5 varies the 1 KHz period from below 950 to above 1050 microseconds. While observing the oscilloscope, adjust the period for 1000 usec (1 ms).

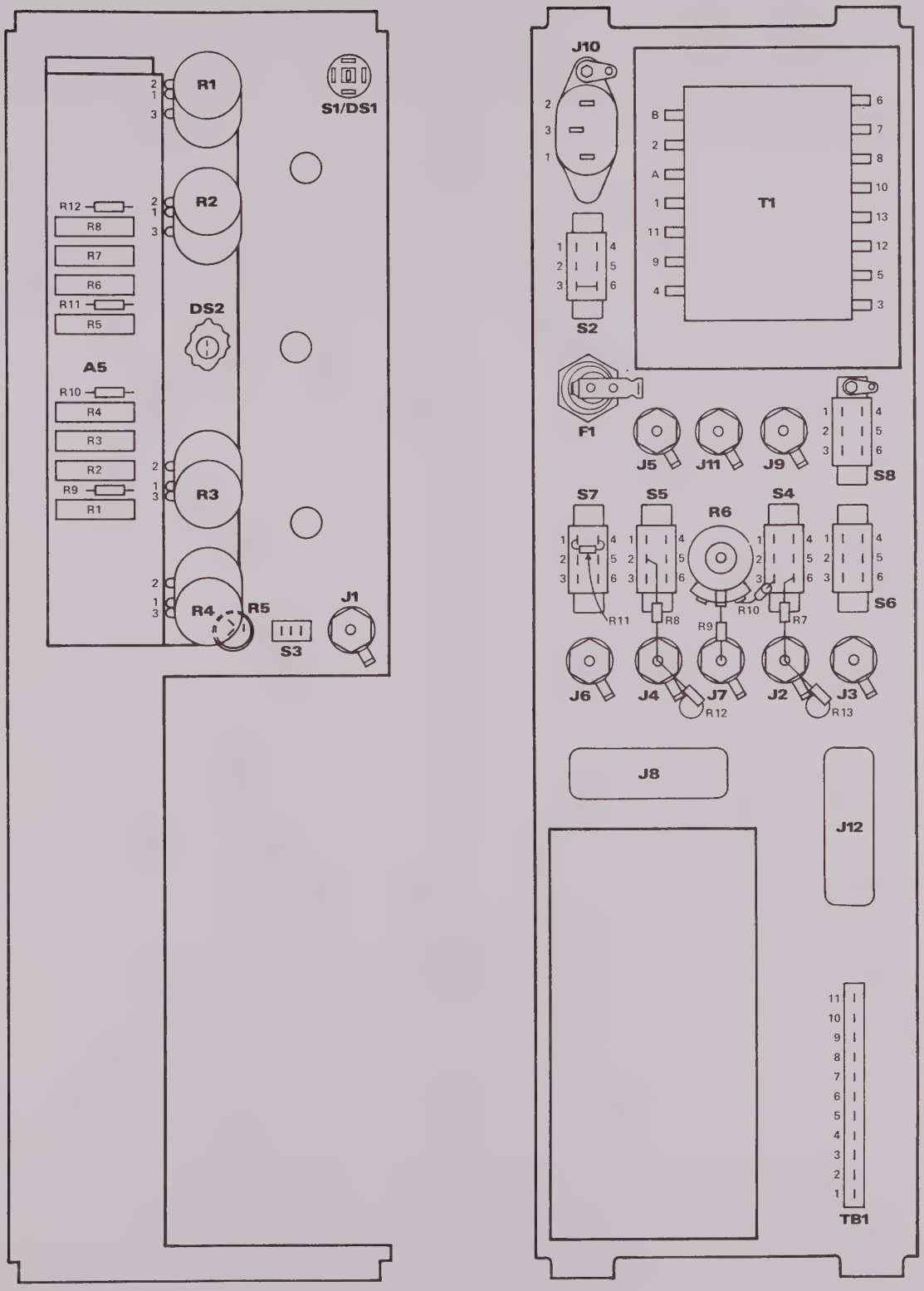
e. Amplitude of the square wave as indicated on the oscilloscope should be 12 (±3) volts peak-to-peak.

5.6 Servicing

Removing the top cover of the Mainframe provides access to its interior. The plug-in cards, (See Figure 6-1) may then be readily exchanged or checked. Their circuit functions are printed on the underside of the top cover to facilitate fault location. Removing both top and bottom covers enables one to operate the unit while also providing access to test points.

The following is a list of Figures which illustrate the locations of the various components and test points:

Figure 5-7	Main assembly components — inside of front and rear panels
Figure 6-3	Assembly A1 components and test points
Figure 6-7	Assembly A2 components and test points
Figure 6-9	Assembly A3 components and test points
Figure 6-1	Assembly A4 components and test points
Figure 5-7	Assembly A5 components



Front Panel, Rear View

Rear Panel, Rear View

Figure 5-7. Identification of Main Assembly Components Located on Front and Back Panels.

5.7 REPLACEABLE PARTS LIST

The replaceable parts for the Model 430A are listed in Tables 5-3 through 5-8 . The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment.

TABLE 5-3. MAIN ASSEMBLY PARTS LIST (C139-188)

Reference Designation	Part Number	Description
DS1	P/O S1	Indicator
DS2	12-191	Indicator
F1	52-1-3	Fuse, 3 amp, (115V operation)
	52-1-1.5	Fuse, 1.5 amp, (230V operation)
J1	63-5	Connector, BNC
J2	63-5	Connector, BNC
J3	63-5	Connector, BNC
J4	63-5	Connector, BNC
J5	63-5	Connector, BNC
J6	63-5	Connector, BNC
J7	63-5	Connector, BNC
J8	63-157	Connector
J9	63-5	Connector, BNC
J10	62-156	Receptacle, AC
J11	63-5	Connector, BNC
J12	62-150	Connector, receptacle
P1	62-151	Connector, plug, 22 pin
P2	62-151	Connector, plug, 22 pin
R1	B20-191	Res, var, WW, 1K, 5%, 2W
R2	B20-191	Res, var, WW, 1K, 5%, 2W
R3	B20-191	Res, var, WW, 1K, 5%, 2W
R4	B20-191	Res, var, WW, 1K, 5%, 2W
R5	20-193-1000	Res, var, WW, 1K, 10%, 2W
R6	20-192-10K	Res, var, WW, 10K, 10%, ½W
R7	25-18-4700	Res, comp, 4.7K, 10%, ¼W
R8	25-18-4700	Res, comp, 4.7K, 10%, ¼W
R9	25-18-2200	Res, comp, 2.2K, 10%, ¼W
R10	25-18-2200	Res, comp, 2.2K, 10%, ¼W
R11	25-18-22K	Res, comp, 22K, 10%, ¼W
R12	25-18-4700	Res, comp, 4.7K, 10%, ¼W
R13	25-18-4700	Res, comp, 4.7K, 10%, ¼W
R14	25-18-47K	Res, comp, 47K, 10%, ¼W
R15		See Figure 6-2, Note 4

TABLE 5-3. MAIN ASSEMBLY PARTS LIST (C139-188)(cont)

Reference Designation	Part Number	Description
S1	55-54	Switch, PresLite
S2	57-15	Switch, DPDT, Locking
S3	55-51	Switch, SPDT, locking
S4	57-12	Switch, SPDT, locking
S5	57-12	Switch, SPDT, locking
S6	57-12	Switch, SPDT, locking
S7	57-12	Switch, SPDT, locking
S8	57-12	Switch, SPDT, locking
T1	C40-133	Transformer, power
TB1	65-6-9	Block, terminal
W1	68-18	Line-cord
	C139-122	Bail
	62-149	Connector, plug, Cinch
	C139-240	Extender, Board
	B139-61	Foot, Molded
	51-24	Fuseholder

TABLE 5-4. ASSEMBLY A1, SWEEP AND MARKER GENERATOR PARTS LIST (C139-128)

Reference Designation	Part Number	Description
A1C1	34-21-R001	Cap, ceramic, 1000pf, 10%, 200V
A1C2	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A1C3	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A1C4	34-21-R001	Cap, ceramic, 1000 pf, 10%, 200V
A1C5	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A1C6	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A1C7	31-66	Cap, elect, 100 μf, 25V
A1C8	31-66	Cap, elect, 100 μf, 25V
A1C9	34-21-100	Cap, ceramic, 100 pf, 10%, 200V
A1C10	34-21-R001	Cap, ceramic, 1000 pf, 10%, 200V
A1C11	34-21-R0022	Cap, ceramic, 2200 pf, 10%, 200V
A1C12	34-21-4700	Cap, ceramic, 4700 pf, 10%, 200V
A1C13	34-21-470	Cap, ceramic, 470 pf, 10%, 200V
A1C14	34-21-100	Cap, ceramic, 100 pf, 10%, 200V
A1C15	31-66	Cap, elect, 100 μf, 25V
A1C16	34-21-15	Cap, ceramic, 15 pf, 10%, 200V
A1C17	34-21-3R3	Cap, ceramic, 3.3 pf, 5%, 200V
A1C18	34-21-47	Cap, ceramic, 47 pf, 10%, 200V
A1C19	34-21-15	Cap, ceramic, 15 pf, 10%, 200V
A1C20	31-66	Cap, elect, 100 μf, 25V
A1C21	34-21-3R3	Cap, ceramic, 3.3 pf, 5%, 200V
A1C22	34-21-47	Cap, ceramic, 47 pf, 10%, 200V
A1C23	34-22-R1	Cap, ceramic, 0.1, 10%, 100V
A1CR1	12-71	Diode, Zener, 1N753A, 6.2V
A1CR2	12-51	Diode, 1N914
A1CR3	12-51	Diode, 1N914
A1CR4	12-51	Diode, 1N914
A1CR5	12-51	Diode, 1N914
A1CR6	12-51	Diode, 1N914
A1CR7	12-51	Diode, 1N914
A1CR8	12-51	Diode, 1N914
A1CR9	12-51	Diode, 1N914
A1CR10	12-51	Diode, 1N914
A1CR11	12-51	Diode, 1N914
A1CR12	12-51	Diode, 1N914
A1CR13	12-51	Diode, 1N914
A1CR14	12-51	Diode, 1N914
A1CR15	12-51	Diode, 1N914
A1CR16	12-51	Diode, 1N914
A1CR17	12-51	Diode, 1N914
A1CR18	12-51	Diode, 1N914
A1CR19	12-51	Diode, 1N914
A1CR20	12-51	Diode, 1N914
A1CR21	12-51	Diode, 1N914
A1CR22		Not Used
A1CR23	12-51	Diode, 1N914
A1CR24	12-51	Diode, 1N914
A1CR25	12-51	Diode, 1N914
A1CR26	12-51	Diode, 1N914

TABLE 5-4. ASSEMBLY A1, SWEEP AND MARKER GENERATOR PARTS LIST (C139-128) (cont)

Reference Designation	Part Number	Description
A1CR27	12-51	Diode, 1N914
A1CR28	12-51	Diode, 1N914
A1CR29	12-51	Diode, 1N914
A1CR30	12-51	Diode, 1N914
A1CR31	12-51	Diode, 1N914
A1CR32	12-51	Diode, 1N914
A1CR33	12-51	Diode, 1N914
A1CR34	12-51	Diode, 1N914
A1CR35	12-212	Diode, Zener, 1N759 A
A1CR36	12-51	Diode, 1N914
A1CR37	12-51	Diode, 1N914
A1CR38	12-51	Diode, 1N914
A1CR39	12-51	Diode, 1N914
A1CR40	12-51	Diode, 1N914
A1CR41	12-51	Diode, 1N914
A1CR42	12-51	Diode, 1N914
A1CR43	12-51	Diode, 1N914
A1CR44	12-51	Diode, 1N914
A1CR45	12-51	Diode, 1N914
A1IC1	12-192	Circuit, Integrated (MOT)
A1IC2	12-192	Circuit, Integrated (MOT)
A1IC3	12-192	Circuit, Integrated (MOT)
A1IC4	12-192	Circuit, Integrated (MOT)
A1IC5	12-192	Circuit, Integrated (MOT)
A1IC6	12-171	Circuit, Integrated (MOT)
A1Q1	12-140	Transistor, 2N4403
A1Q2	12-140	Transistor, 2N4403
A1Q3	12-140	Transistor, 2N4403
A1Q4	12-140	Transistor, 2N4403
A1Q5	12-140	Transistor, 2N4403
A1Q6	12-139	Transistor, 2N4401
A1Q7	12-139	Transistor, 2N4401
A1Q8	12-213	Transistor, 2N5184
A1Q9	12-139	Transistor, 2N4401
A1Q10	12-140	Transistor, 2N4403
A1Q11	12-139	Transistor, 2N4401
A1Q12	12-140	Transistor, 2N4403
A1Q13	12-139	Transistor, 2N4401
A1Q14	12-139	Transistor, 2N4401
A1Q15	12-140	Transistor, 2N4401
A1Q16	12-140	Transistor, 2N4403
A1Q17	12-139	Transistor, 2N4403
A1R1	25-15-4R7M	Res, comp, 4.7M, 5%, ¼W
A1R2	25-25-10K	Res, film, 10K, 2%, ¼W
A1R3	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R4	25-25-1000	Res, film, 1K, 2%, ¼W
A1R5	25-25-470	Res, film, 470 ohm, 2%, ¼W
A1R6	25-25-1000	Res, film, 1K, 2%, ¼W
A1R7	25-25-4700	Res, film, 4.7K, 2%, ¼W

TABLE 5-4. ASSEMBLY A1, SWEEP AND MARKER GENERATOR PARTS LIST (C139-128) (cont)

Reference Designation	Part Number	Description
A1R8	25-25-10K	Res, film, 10K, 2%, ¼W
A1R9	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R10	25-25-22K	Res, film, 22K, 2%, ¼W
A1R11	25-25-22K	Res, film, 22K, 2%, ¼W
A1R12	25-25-1500	Res, film, 1.5K, 2%, ¼W
A1R13	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R14	25-25-2200	Res, film, 2.2K, 2%, ¼W
A1R15	25-25-22K	Res, film, 22K, 2%, ¼W
A1R16	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R17	25-25-68K	Res, film, 68K, 2%, ¼W
A1R18	25-25-22K	Res, film, 22K, 2%, ¼W
A1R19	25-25-22K	Res, film, 22K, 2%, ¼W
A1R20	25-25-68K	Res, film, 68K, 2%, ¼W
A1R21	25-25-2200	Res, film, 2.2K, 2%, ¼W
A1R22	25-25-10K	Res, film, 10K, 2%, ¼W
A1R23	25-25-33K	Res, film, 33K, 2%, ¼W
A1R24	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R25	25-25-10K	Res, film, 10K, 2%, ¼W
A1R26	25-25-100	Res, film, 100 ohm, 2%, ¼W
A1R27	25-20-5620	Res, RN60C, 5.62K, 1%, 1/8W
A1R28	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R29	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R30	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R31	25-20-178K	Res, film, 178K, 1%, 1/8W
A1R32	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R33	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R34	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R35	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R36	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R37	25-25-10K	Res, film, 10K, 2%, ¼W
A1R38	25-25-10K	Res, film, 10K, 2%, ¼W
A1R39	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R40	25-25- 47	Res, film, 47 ohm, 2%, ¼W
A1R41	25-25-10K	Res, film, 10K, 2%, ¼W
A1R42	25-25-470	Res, film, 470 ohm, 2%, ¼W
A1R43	25-25-10K	Res, film, 10K, 2%, ¼W
A1R44	25-25-10K	Res, film, 10K, 2%, ¼W
A1R45	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R46	26-95-15K	Res, film, 15K, 0.05%, 1/8W
A1R47	25-25-100	Res, film, 100 ohm, 2%, ¼W
A1R48	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A1R49	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A1R50	25-15-1R5M	Res, comp, 1.5M, 5%, ¼W
A1R51	20-187	Res, adjustable, 10K
A1R52	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A1R53	25-25-3300	Res, film, 3.3K, 2%, ¼W
A1R54	25-15-1R5M	Res, comp, 1.5M, 5%, ¼W
A1R55	20-187	Res, adjustable, 10K
A1R56	25-20-100K	Res, film, 100K, 1%, 1/8W

TABLE 5-4. ASSEMBLY A1, SWEEP AND MARKER GENERATOR PARTS LIST (C139-128) (cont)

Reference Designation	Part Number	Description
A1R57	25-20-100K	Res, film, 100K, 1%, 1/8W
A1R58	26-95-2000	Res, film, 2K, 0.05%, 1/8W
A1R59	26-95-2000	Res, film, 2K, 0.05%, 1/8W
A1R60	25-15-1M	Res, comp, 1M, 5%, ¼W
A1R61	20-187	Res, adjustable, 10K
A1R62	25-25-680	Res, film, 680 ohm, 2%, ¼W
A1R63	26-95-2000	Res, film, 2K, 0.05%, 1/8W
A1R64	25-20-3010	Res, film, 3.01K, 1%, 1/8W
A1R65	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R66	25-20-2150	Res, film, 2.15K, 1%, 1/8W
A1R67	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R68	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R69	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R70	25-20-10K	Res, film, 10K, 1%, 1/8W
A1R71	25-25-10K	Res, film, 10K, 2%, ¼W
A1R72	25-25-2200	Res, film, 2.2K, 2%, ¼W
A1R73	25-8-6800	Res, comp, 6.8K, 5%, ½W
A1R74	25-25-470	Res, film, 470 ohm, 2%, ¼W
A1R75	26-95-100K	Res, film, 100K, 0.05%, 1/8W
A1R76	26-95-100K	Res, film, 100K, 0.05%, 1/8W
A1R77	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R78	25-15-1R5M	Res, comp, 1.5M, 5%, ¼W
A1R79	25-25-47K	Res, film, 47K, 2%, ¼W
A1R80	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R81	25-25-100K	Res, film, 100K, 2%, ¼W
A1R82	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R83	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R84	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R85	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R86	25-20-1400	Res, film, 1.4K, 1%, 1/8W
A1R87	25-25-100K	Res, film, 100K, 2%, ¼W
A1R88	25-25-15K	Res, film, 15K, 2%, ¼W
A1R89	25-25-1000	Res, film, 1K, 2%, ¼W
A1R90	26-95-100K	Res, film, 100K, 0.05%, 1/8W
A1R91	26-95-100K	Res, film, 100K, 0.05%, 1/8W
A1R92	20-187	Res, adjustable, 10K
A1R93	25-15-1R5M	Res, comp, 1.5M, 5%, ¼W
A1R94	20-187	Res, adjustable, 10K
A1R95	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R96	25-25-47K	Res, film, 47K, 2%, ¼W
A1R97	25-25-220	Res, film, 220 ohm, 2%, ¼W
A1R98	25-25-100K	Res, film, 100K, 2%, ¼W
A1R99	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R100	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R101	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A1R102	25-20-2800	Res, film, 2.8K, 1%, 1/8W
A1R103	25-20-1400	Res, film, 1.40K, 1%, 1/8W
A1R104	25-25-100K	Res, film, 100K, 2%, ¼W
A1R105	25-25-15K	Res, film, 15K, 2%, ¼W

TABLE 5-4. ASSEMBLY A1, SWEEP AND MARKER GENERATOR PARTS LIST (C139-128) (cont)

Reference Designation	Part Number	Description
A1R106	25-25-1000	Res, film, 1K, 2%, ¼W
A1R107	25-25-15K	Res, film, 15K, 2%, ¼W
A1R108	25-25-100	Res, film, 100 ohm, 2%, ¼W
A1R109	25-25-1500	Res, film, 1.5 ohm, 2%, ¼W
A1R110	25-25-100K	Res, film, 100K, 2%, ¼W
A1R111	25-25-1500	Res, film, 1.5K, 2%, ¼W
A1R112	25-25-100	Res, film, 100K, 2%, ¼W
A1R113	25-20-10K	Res, film, 10K , 1%, 1/8W
A1R114	25-20-8060	Res, film, 8.06K, 1%, 1/8W
A1R115	25-20-2550	Res, film, 2.55K, 1%, 1/8W
A1R116	25-25-6800	Res, film, 6.8K, 2%, ¼W
A1R117	25-20-3160	Res, film, 3.16K, 1%, 1/8W
A1R118	25-25-4700	Res, film, 4.7K, 2%, ¼W
A1R119	25-25-100K	Res, film, 100K, 2%, ¼W
A1R120	25-25-1000	Res, film, 1K, 2%, ¼W
A1R121	25-25-1500	Res, film, 1.5K, 2%, ¼W

TABLE 5-5. ASSEMBLY A2, POWER SUPPLY PARTS LIST (C139-12)

Reference Designation	Part Number	Description
A2C1	33-35-R1	Cap, mylar, 0.1 μf, 10%, 200V
A2C2	31-82	Cap, elect, 2200 μf, 25V
A2C3	31-66	Cap, elect, 100 μf, 25V
A2C4	31-80	Cap, elect, 10 μf, 35V
A2C5	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A2C6	34-21-39	Cap, ceramic, 39 pf, 10%, 200V
A2C7	34-21-56	Cap, ceramic, 56 pf, 10%, 200V
A2C8	34-21-150	Cap, ceramic, 150 pf, 10%, 200V
A2C9	34-21-100	Cap, ceramic, 100 pf, 10%, 200V
A2C10	31-2	Cap, elect, 2200 μf, 25V
A2C11	34-23-R22	Cap, ceramic, 0.22 μf, 50V
A2C12	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A2C13	34-21-4700	Cap, ceramic, 4700 pf, 10%, 200V
A2C14	31-66	Cap, elect, 100 μf, 25V
A2C15	31-82	Cap, elect, 50 μf, 25V
A2C16	31-66	Cap, elect, 100 μf, 25V
A2C17	34-21-220	Cap, ceramic, 220 pf, 10%, 200V
A2C18	31-80	Cap, elect, 10 μf, 35V
A2C19	34-21-150	Cap, ceramic, 150 pf, 10%, 200V
A2C20	34-21-100	Cap, ceramic, 100 pf, 10%, 200V
A2C21	34-21-39	Cap, ceramic, 39 pf, 10%, 200V
A2C22	34-21-56	Cap, ceramic, 56 pf, 10%, 200V
A2C23	31-2	Cap, elect, 50 μf, 25V
A2C24	33-35-R1	Cap, mylar, 0.1 μf, 10%, 200V
A2C25	31-83	Cap, elect, 4000 μf, 15V
A2C26	34-21-R001	Cap, ceramic, 0.001 μf, 10%, 200V
A2C27	34-21-56	Cap, ceramic, 56 pf, 10%, 200V
A2C28	34-21-150	Cap, ceramic, 150 pf, 10%, 200 V
A2C29	34-21-39	Cap, ceramic, 39 pf, 10%, 200V
A2C30	34-21-100	Cap, ceramic, 100 pf, 10%, 200V
A2C31	31-2	Cap, elect, 50 μf, 25V
A2C32	34-21-R01	Cap, ceramic, 0.01 μf, 10%, 200V
A2CR1	12-193	Bridge, rectifier
A2CR2	12-99	Diode, 1N483B
A2CR3	12-51	Diode, 1N914
A2CR4	12-51	Diode, 1N914
A2CR5	12-214	Diode, Zener, 1N3499
A2CR6	12-51	Diode, 1N914
A2CR7	12-51	Diode, 1N914
A2CR8	12-51	Diode, 1N914
A2CR9	12-99	Diode, 1N483B
A2CR10	12-193	Bridge, rectifier
A2CR11	12-51	Diode, 1N914
A2CR12	12-51	Diode, 1N914
A2CR13	12-71	Diode, Zener, 6.2V
A2IC1	12-171	Circuit, Integrated
A2IC2	12-171	Circuit, Integrated
A2Q1	12-178	Transistor, MJ1000 (MOT)
A2Q2	12-140	Transistor, 2N4403

TABLE 5-5. ASSEMBLY A2, POWER SUPPLY PARTS LIST (C139-12) (cont)

Reference Designation	Part Number	Description
A2Q3	12-140	Transistor, 2N4403
A2Q4	12-139	Transistor, 2N4401
A2Q5	12-177	Transistor, MJ900 (MOT)
A2Q6	12-140	Transistor, 2N4403
A2Q7	12-140	Transistor, 2N4403
A2Q8	12-140	Transistor, 2N4403
A2Q9	12-140	Transistor, 2N4403
A2Q10	12-177	Transistor, MJ900 (MOT)
A2Q11	!2-140	Transistor, 2N4403
A2Q12	12-215	SCR, 2N4441
A2R1	25-25-820	Res, film 820 ohm, 2% ¼W
A2R2	25-25-1800	Res, film, 1.8K, 2%, ¼W
A2R3	25-25-1000	Res, film, 1K, 2%, ¼W
A2R4	25-25-2000	Res, film, 2K, 2%, ¼W
A2R5	25-25-100	Res, film, 100 ohm, 2%, ¼W
A2R6	25-25-1000	Res, film, 1K, 2%, ¼W
A2R7	26-81-R47	Res, WW, 0.47 ohm, 5%, 2W
A2R8	25-25-1200	Res, film, 1.2K, 2%, ¼W
A2R9	25-23-14R7K	Res, film, 14.7K 1%, 1/8W
A2R10	20-184	Res, WW, variable, 500 ohm
A2R11	25-23	Res, film, selected, 1%, 1/8W
A2R12	25-25-4700	Res, film, 4.7K, 2%, ¼W
A2R13	25-20-1210	Res, film, 1.21K, 1%, 1/8W
A2R14	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A2R15	26-95-3K	Res, film, 3K, 0.05%, 1/8W
A2R16	25-25-1200	Res, film, 1.2K, 2%, ¼W
A2R17	26-95-2K	Res, film, 2K, 0.05%, 1/8W
A2R18	25-25-1500	Res, film, 1.5K, 2%, ¼W
A2R19	25-25-220	Res, film, 220 ohm, 2%, ¼W
A2R20	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A2R21	25-8-47	Res, comp, 47 ohm, 5%, ½W
A2R22	25-25-4700	Res, film, 4.7K, 2%, ¼W
A2R23	25-25-1000	Res, film, 1K, 2%, ¼W
A2R24	25-25-2000	Res, film, 2K, 2%, ¼W
A2R25	25-25-1000	Res, film, 1K, 2%, ¼W
A2R26	25-25-100	Res, film, 100 ohm, 2%, ¼W
A2R27	26-81-R47	Res, WW, 0.47 ohm, 5%, 2W
A2R28	25-25-1200	Res, film, 1.2K, 2%, ¼W
A2R29	25-15-10	Res, comp, 10 ohm, 5%, ¼W
A2R30	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A2R31	26-81-R47	Res, WW, 0.47 ohm, 5%, 2W
A2R32	25-25-1800	Res, film, 1.8K, 2%, ¼W
A2R33	25-25-1200	Res, film, 1.2K, 2%, ¼W
A2R34	25-20-15K	Res, film, 15K, 1%, 1/8W
A2R35	25-25-3300	Res, film, 3.3K, 2%, ¼W
A2R36	25-20-5110	Res, film, 5.11K, 1%, 1/8W
A2R37	25-25-100	Res, film, 100 ohm, 2%, ¼W

TABLE 5-6. ASSEMBLY A3, REMOTE PROGRAMMING PARTS LIST (C139-90)

Reference Designation	Part Number	Description
A3CR1	12-99	Diode, IN483B
A3IC1	12-199	Circuit, Integrated
A3IC2	12-199	Circuit, Integrated
A3IC3	12-199	Circuit, Integrated
A3IC4	12-164	Circuit, Integrated
A3IC5	12-200	Circuit, Integrated, D-A Conv.
A3K1	47-29	Relay
A3Q1	12-139	Transistor, 2N4401
A3R1	20-187	Res, var, 10K, 2%, ¼W
A3R2	20-187	Res, var, 10K, 2%, ¼W
A3R3	20-184	Res, var, 500 ohm, 2%, ¼W
A3R4	25-28-5110	Res, RN60E, 5.11K, 1%, 1/8W
A3R5	25-25-6800	Res, film, 6.8K, 2%, ¼W
A3R6	25-25-6800	Res, film, 6.8K, 2%, ¼W

TABLE 5-7. ASSEMBLY A4, MOTHERBOARD PARTS LIST (C139-19)

Reference Designation	Part Number	Description
A4A1	C139-203	Sweep Function Switch Assy.
A4A2	C139-204	Sweep Trigger Switch Assy.
A4C1	33-35-R2	Cap, mylar, 0.22 µf, 10%, 200V
A4C2	33-35-R2	Cap, mylar, 0.22 µf, 10%, 200V
A4C3	33-35-R1	Cap, mylar, 0.1 µf, 10%, 200V
A4C4	33-35-R1	Cap, mylar, 0.1 µf, 10%, 200V
A4C5	33-35-R1	Cap, mylar, 0.1 µf, 10%, 200V
A4C6	33-19-R047	Cap, mylar, 0.047 µf, 10%, 100V
A4C7	31-29	Cap, elect, 20 µf, 50V
A4C8	31-87	Cap, elect,1000µf, 50V
A4C9	31-88	Cap, elect, 1100 µf, 50V
A4C10	31-87	Cap, elect,1000µf, 50V
A4C11	31-89	Cap, elect, 40 µf, 450V
A4C12	34-21-R1	Cap, ceramic, 0.1 µf, 100V
A4CR1	12-71	Diode, Zener
A4CR2	12-99	Diode, 1N483B
A4CR3	12-99	Diode, 1N483B
A4CR4	12-216	Diode
A4CR5	12-216	Diode
A4CR6	12-216	Diode
A4CR7	12-193	Diode, Bridge Rectifier
A4CR8	12-193	Diode, Bridge Rectifier
A4CR9	12-193	Diode, Bridge Rectifier
A4J1	6-152	Connector, PC, 18-pin
A4J2	6-152	Connector, PC, 18-pin
A4J3	6-152	Connector, PC, 18-pin
A4J4	6-152	Connector, PC, 18-pin
A4K1	47-30	Relay, single pole, form A
A4Q1	12-139	Transistor, 2N4401
A4Q2	12-139	Transistor, 2N4401
A4R1	25-25-15K	Res, film, 15K, 2%, ¼W
A4R2	25-25-15K	Res, film, 15K, 2%, ¼W
A4R3	25-27-180	Res, film, 180 ohm, 2%, ½W
A4R4	25-25-10K	Res, film, 10K, 2%, ¼W
A4R5	25-25-100	Res, film, 100 ohm, 2%, ¼W
A4R6	25-27-330	Res, film, 330 ohm, 2%, ½W
A4R7	25-15-4R7	Res, comp, 4.7 ohm, 5%, ¼W
A4R8	25-15-220	Res, comp, 220 ohm, 5%, ¼W
A4R9	25-15-4R7K	Res, comp, 4.7K, 5%, ¼W
A4R10	26-95-7500	Res, film, 7.5K, 0.05%, 1/8W
A4R11	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A4R12	26-95-10K	Res, film, 10K, 0.05%, 1/8W
A4R13	26-95-15K	Res, film, 15K, 0.05%, 1/8W
A4R14	25-25-10K	Res, film, 10K, 2%, ¼W
A4R15	25-25-68K	Res, film, 68K, 2%, ¼W

TABLE 5-7. ASSEMBLY A4, MOTHERBOARD PARTS LIST (C139-19) (cont)

Reference Designation	Part Number	Description
A4R16	25-25-10K	Res, film, 10K, 2%, ¼W
A4R17	25-15-1M	Res, comp, 1M, 5%, ¼W
A4R18	25-20-147K	Res, film, 147K, 1%, 1/8W
A4R19	25-27-680	Res, film, 680 ohm, 2%, ½W
A4R20	25-15-22	Res, comp, 22 ohm, 5%, ¼W
A4R21	25-20-2R55K	Res, film, 2.55K, 1%, 1/8W
A4S1	56-71	Switch, Rotary
A4A1	C139-203	Sweep Function Switch Assy.
A4A1R1	26-95-7500	Res, film, 7.5K, 0.05%, 1/8W
A4A1S1	56-70	Switch, rotary
A4A2	C139-204	Sweep Trigger Switch Assy.
A4A2C1	33-19-R1	Cap, mylar, 0.1 μf, 10%, 50V
A4A2C2	31-84	Cap, tant, 1 μf, 20%20V
A4A2C3	31-85	Cap, tant, 10 μf, 20%, 20V
A4A2C4	31-86	Cap, tant, 100 μf, 20%, 20V
A4A2R1	P/O 56-69	Res, variable, 1.5M
A4A2R2	25-25-150K	Res, comp, 150K, 10%, ¼W
A4A2R3	25-15-1R5M	Res, comp, 1.5M, 5%, ¼W
A4A2S1	56-69	Switch, rotary

TABLE 5-8 . ASSEMBLY A5, TRIMMER BOARD PARTS LIST (C139-131)

Reference Designation	Part Number	Description
A5R1	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R2	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R3	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R4	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R5	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R6	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R7	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R8	20-192-10	Res, var, WW, 10 ohm, 10%, ½W
A5R9	25-20-100K	Res, film, 100K, 1%, 1/8W
A5R10	25-20-100K	Res, film, 100K, 1%, 1/8W
A5R11	25-20-100K	Res, film, 100K, 1%, 1/8W
A5R12	25-20-100K	Res, film, 100K, 1%, 1/8W

SECTION 6
SCHEMATIC DIAGRAMS

6.1 INTRODUCTION

This section contains the schematic diagrams and component identification illustrations for Assemblies A1, A2, A3, and A4. Component identification for A5 is included as part of Figure 5-7. Figure 6-2, provides an overall view of these assemblies and also contains the schematic diagram for the Mainframe, A4 and A5.

6.2 LIST OF FIGURES

The following list shows the figure number, figure title and page number for each figure.

Figure	Title	Page
6-1	Assembly A4, Motherboard Component Location	6-2
6-2	Model 430A Overall Schematic Diagram	6-3/6-4
6-3	Assembly A1, Sweep and Marker Generator Component Identification	6-6
6-4	Sawtooth and Limiter Schematic Diagram (part of A1)	6-7/6-8
6-5	Sweep Amplifier Schematic Diagram (part of A1)	6-9/6-10
6-6	Marker and Square Wave Generator Schematic Diagram (part of A1)	6-11
6-7	Assembly A2, Power Supply Component Location	6-12
6-8	Assembly A2, Power Supply Schematic Diagram	6-13
6-9	Assembly A3, Remote Programming Component Location	6-14
6-10	Assembly A3, Remote Programming Schematic Diagram	6-15/6-16

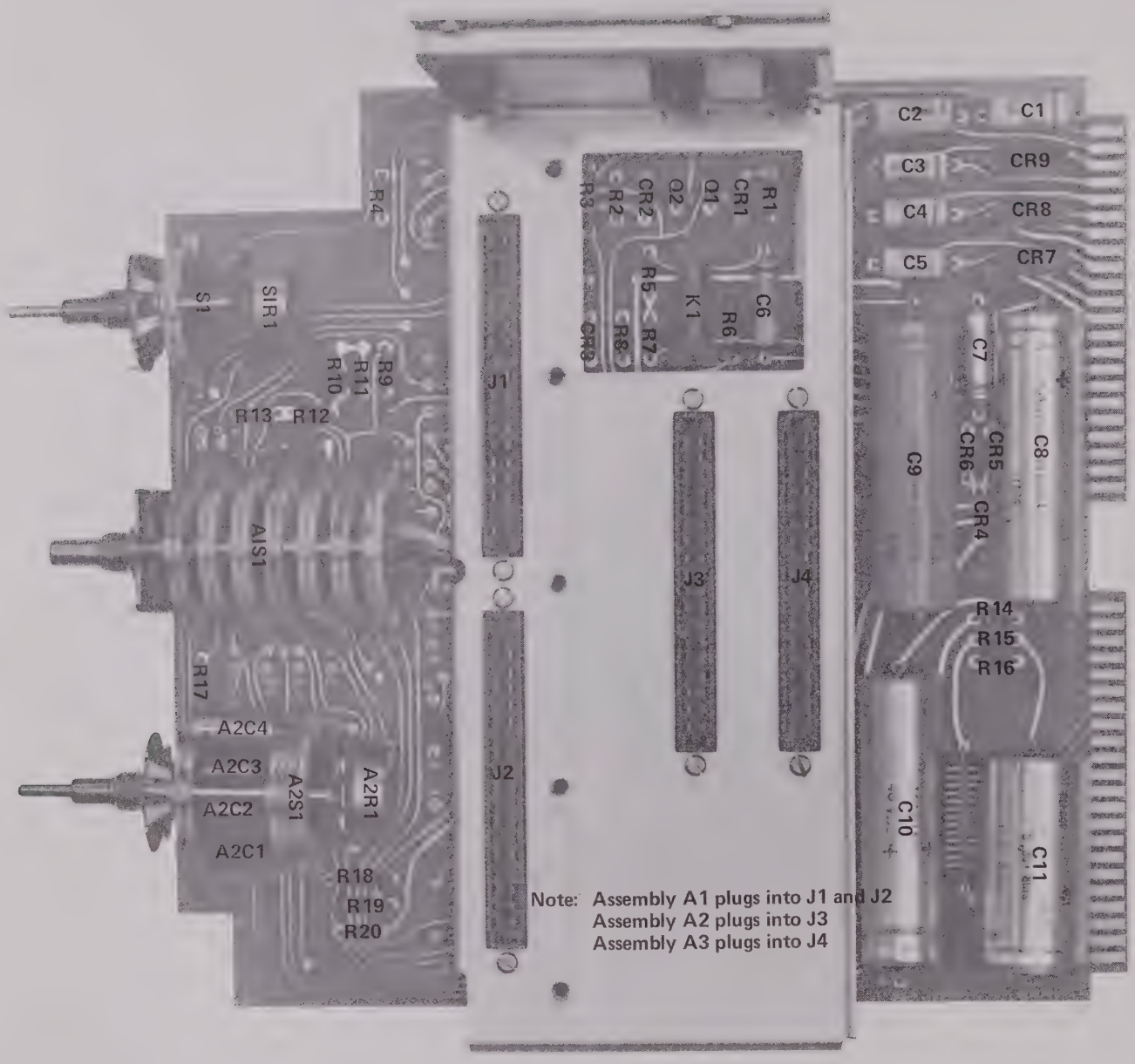


Figure 6-1. Assembly A4, Motherboard Component Location.

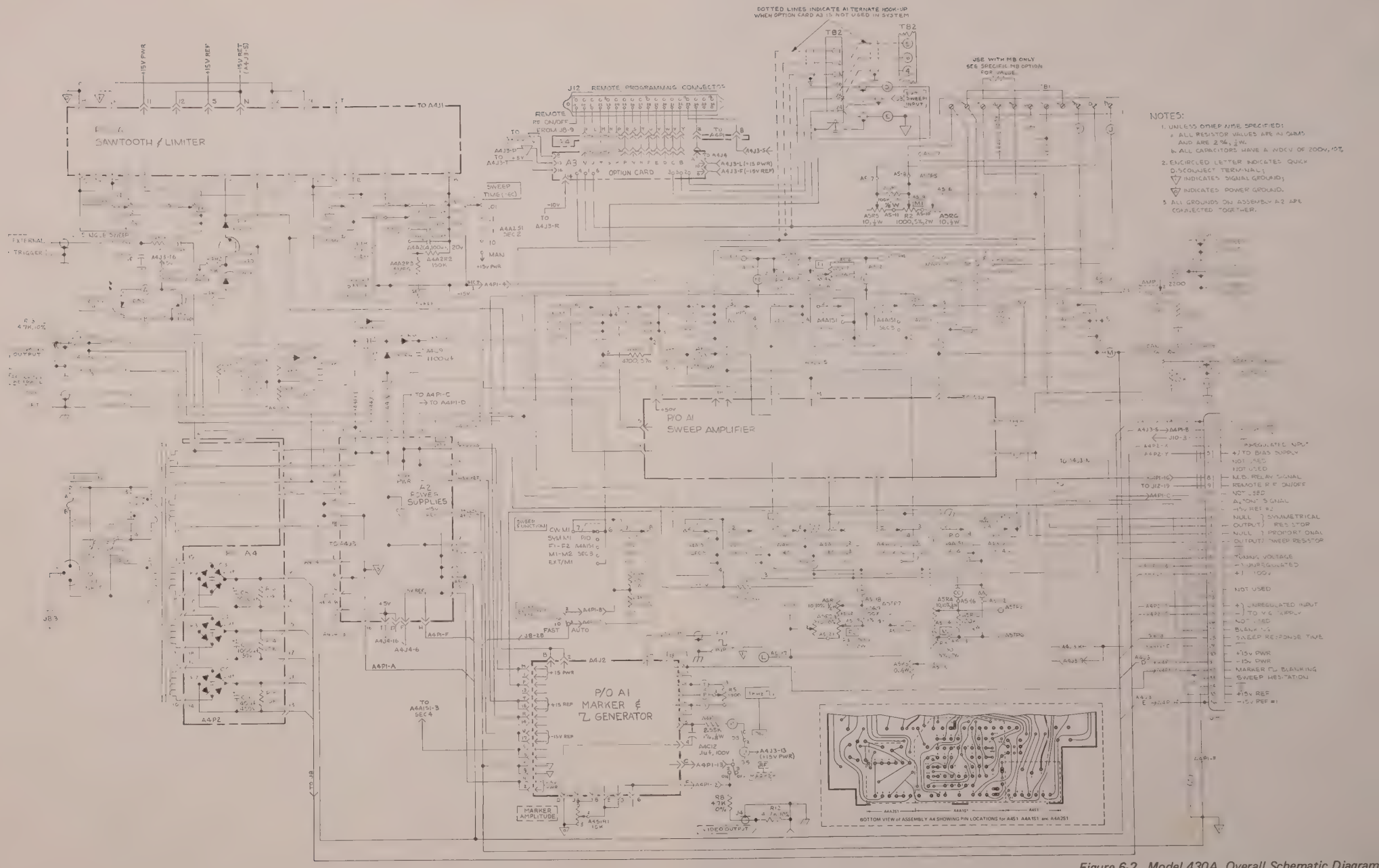

DOTTED LINES INDICATE ALTERNATE HOOK-UP WHEN OPTION CARD A3 IS NOT USED IN SYSTEM
USE WITH MB ONLY SEE SPECIFIC MB OPTION FOR VALUE
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a. ALL RESISTOR VALUES ARE IN OHMS AND ARE 2%, ¼W.
b. ALL CAPACITORS HAVE A WDCV OF 200V, 10%
2. ENCIRCLED LETTER INDICATES QUICK DISCONNECT TERMINAL;
INDICATES SIGNAL GROUND;
INDICATES POWER GROUND.
3. ALL GROUNDS ON ASSEMBLY A2 ARE CONNECTED TOGETHER.
SAWTOOTH & LIMITER
P/O A1 SWEEP AMPLIFIER
A2 POWER SUPPLIES
P/O A1 MARKER & "Z" GENERATOR
A3 OPTION CARD
J12 REMOTE PROGRAMMING CONNECTOR
BOTTOM VIEW of ASSEMBLY A4 SHOWING PIN LOCATIONS for A4S1, A4A1S1 and A4A2S1

Figure 6-2. Model 430A, Overall Schematic Diagram.

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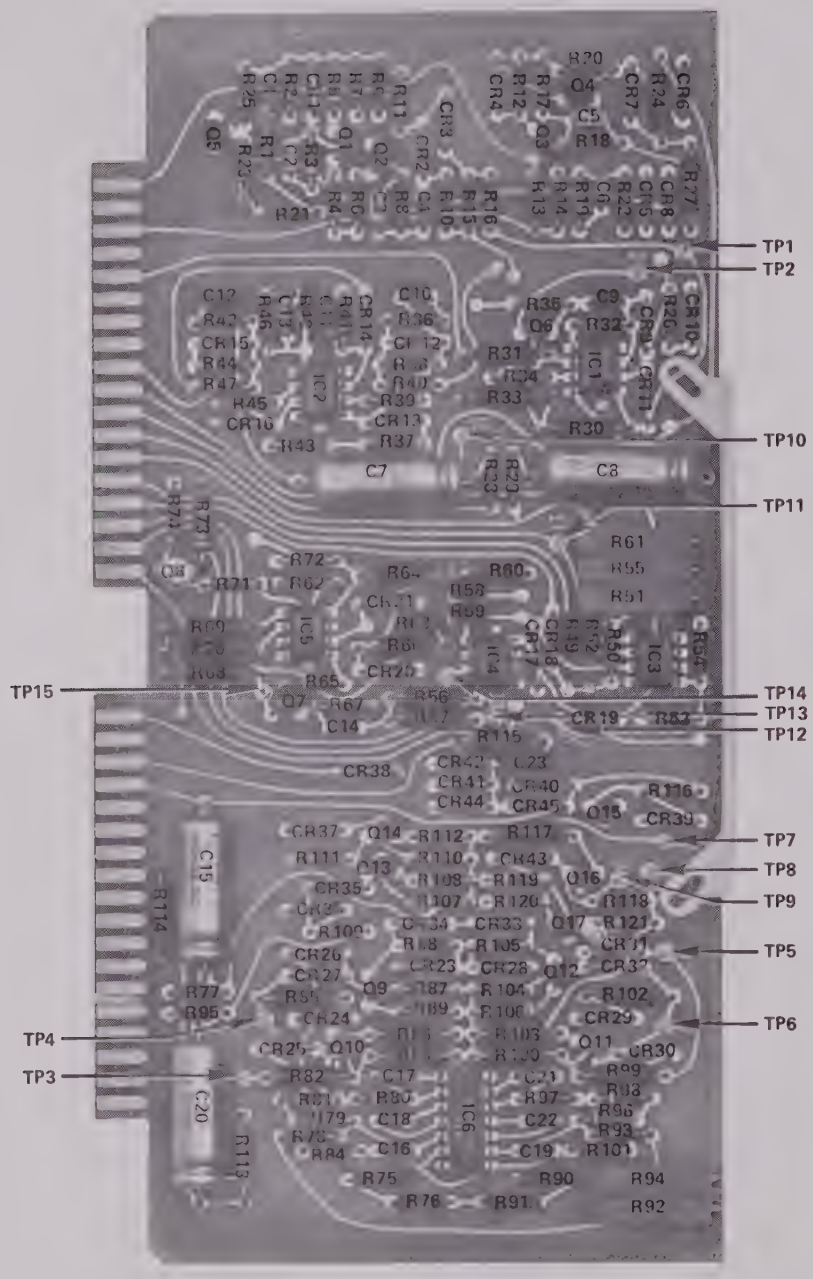


Figure 6-3. Assembly A1, Sweep and Marker Generator Component Identification.

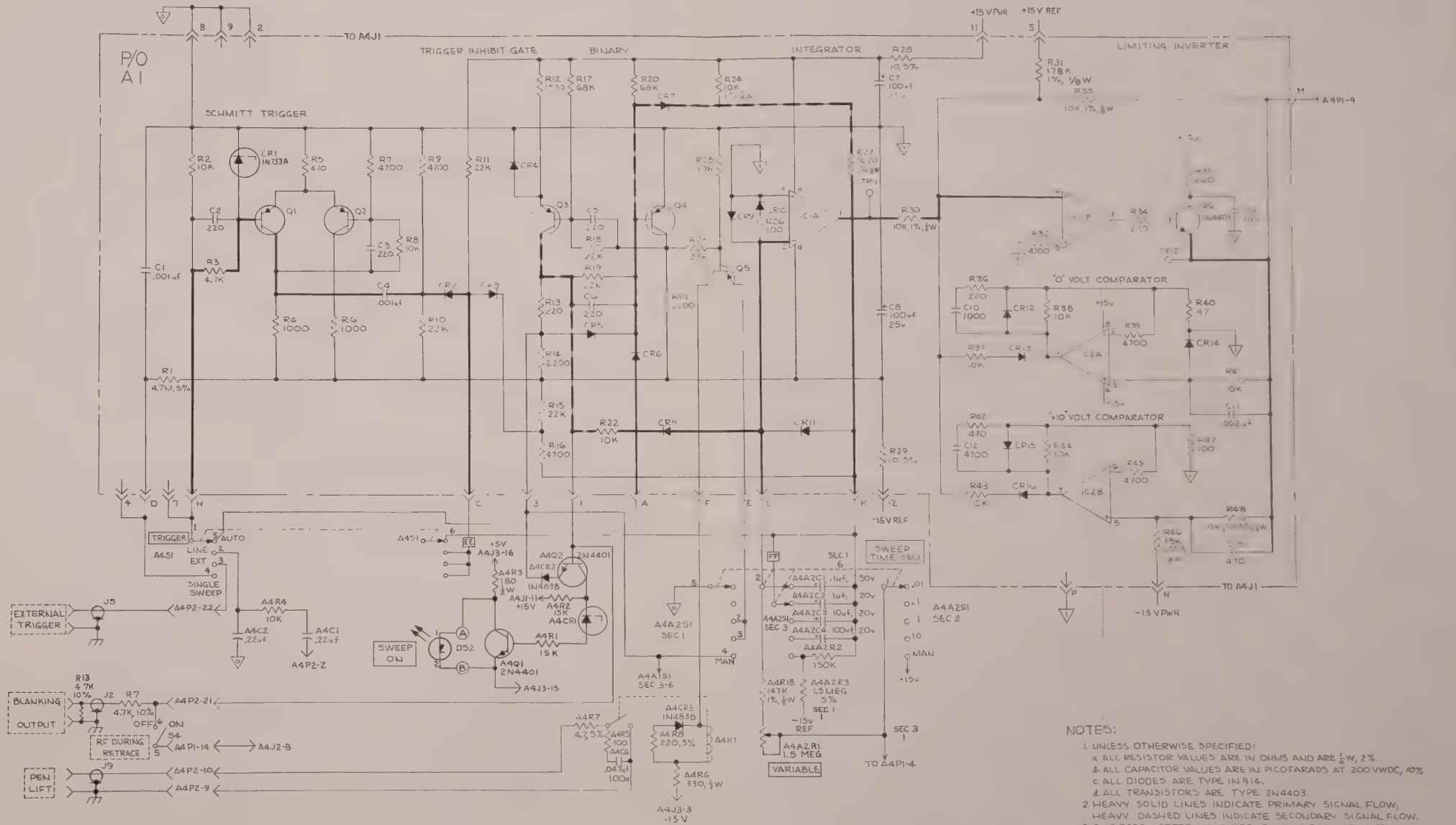


Figure 6-4. Sawtooth and Limiter Schematic Diagram (Part of A1).

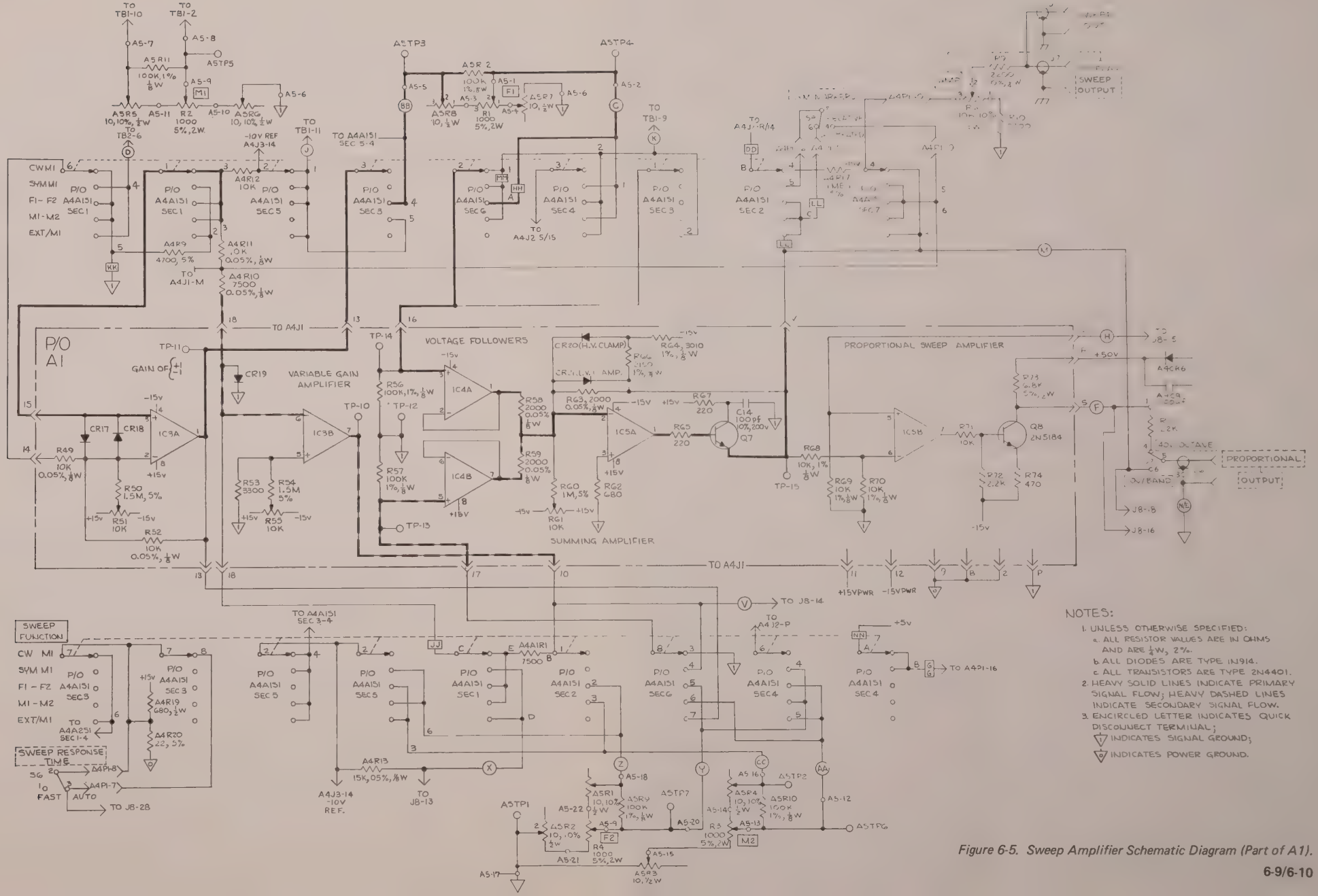
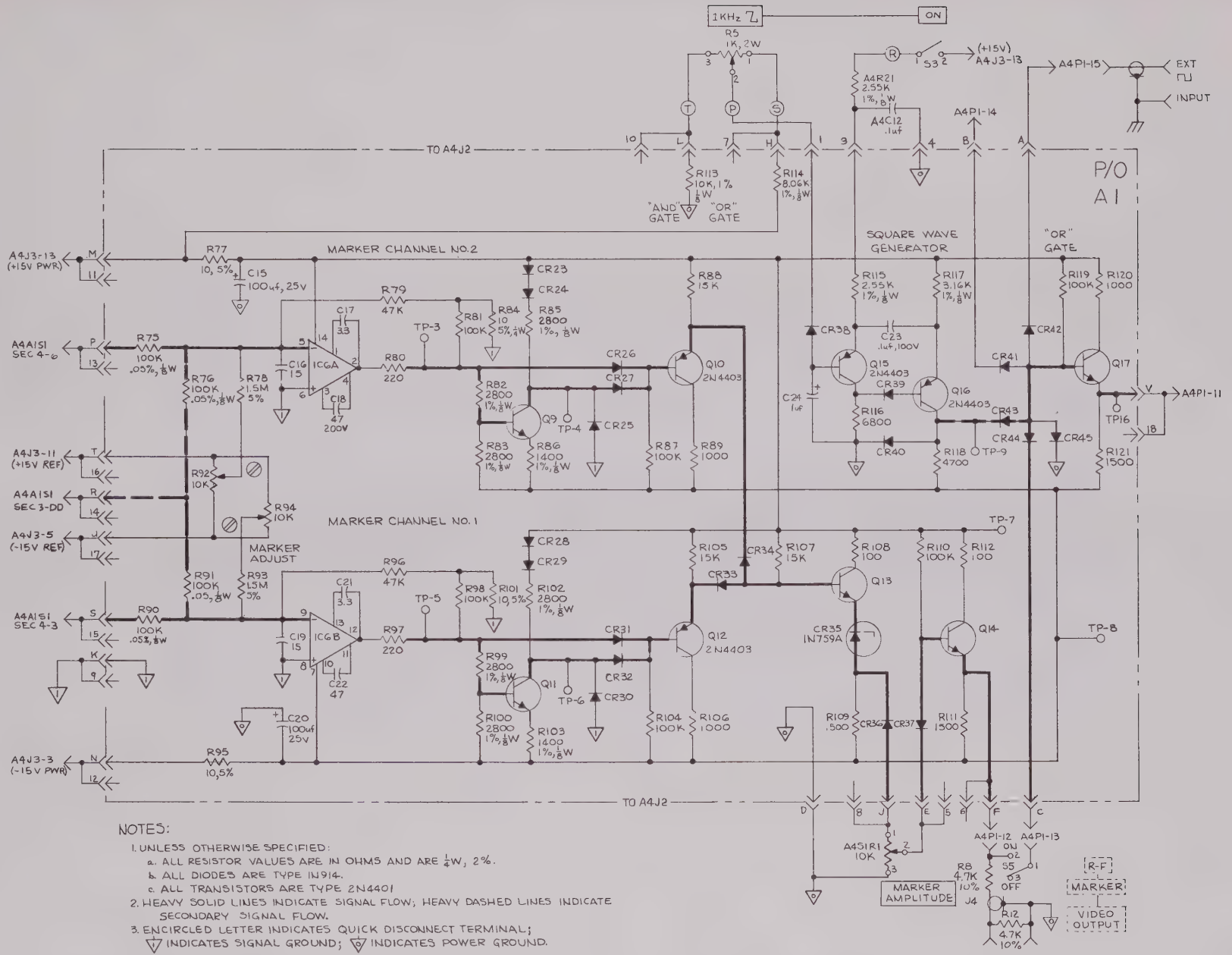


Figure 6-5. Sweep Amplifier Schematic Diagram (Part of A1).



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTOR VALUES ARE IN OHMS AND ARE $\frac{1}{4}$W, 2%.
   b. ALL DIODES ARE TYPE IN914.
   c. ALL TRANSISTORS ARE TYPE 2N4401
2. HEAVY SOLID LINES INDICATE SIGNAL FLOW; HEAVY DASHED LINES INDICATE SECONDARY SIGNAL FLOW.
3. ENCIRCLED LETTER INDICATES QUICK DISCONNECT TERMINAL; ▽ INDICATES SIGNAL GROUND; ▽ INDICATES POWER GROUND.
4. ALL CAPACITOR VALUES ARE IN PICOFARADS AT 200 VWDC, 10%.

Figure 6-6. Marker and Square Wave Generator Schematic Diagram (Part of A1).

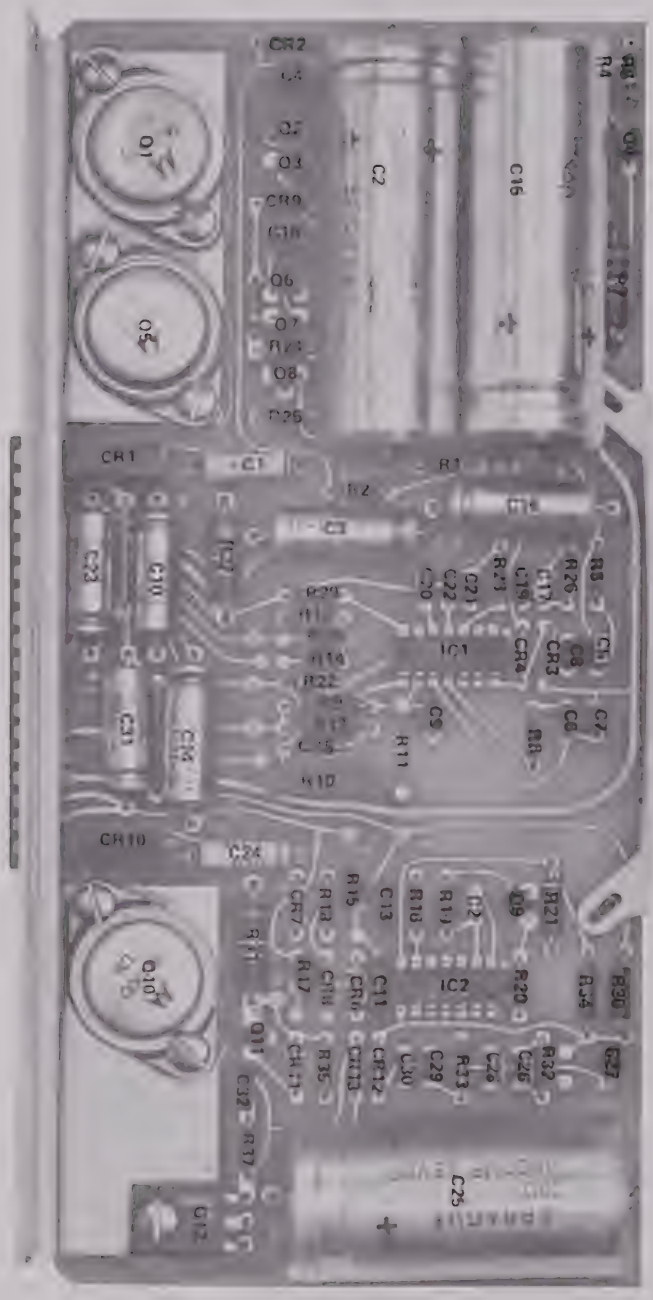


Figure 6-7. Assembly A2, Power Supply Component Identification.

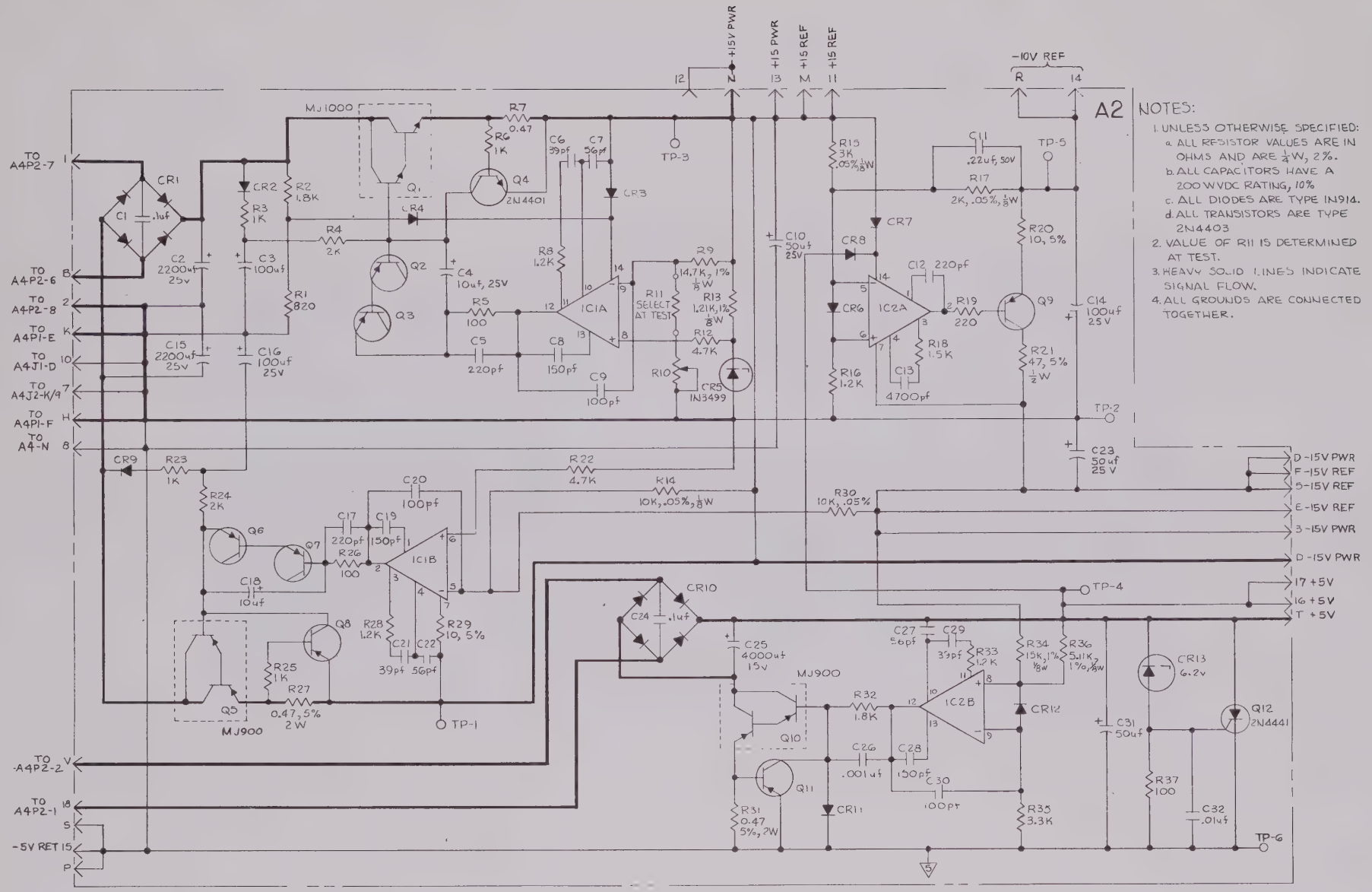


Figure 6-8. Assembly A2, Power Supply Schematic Diagram.

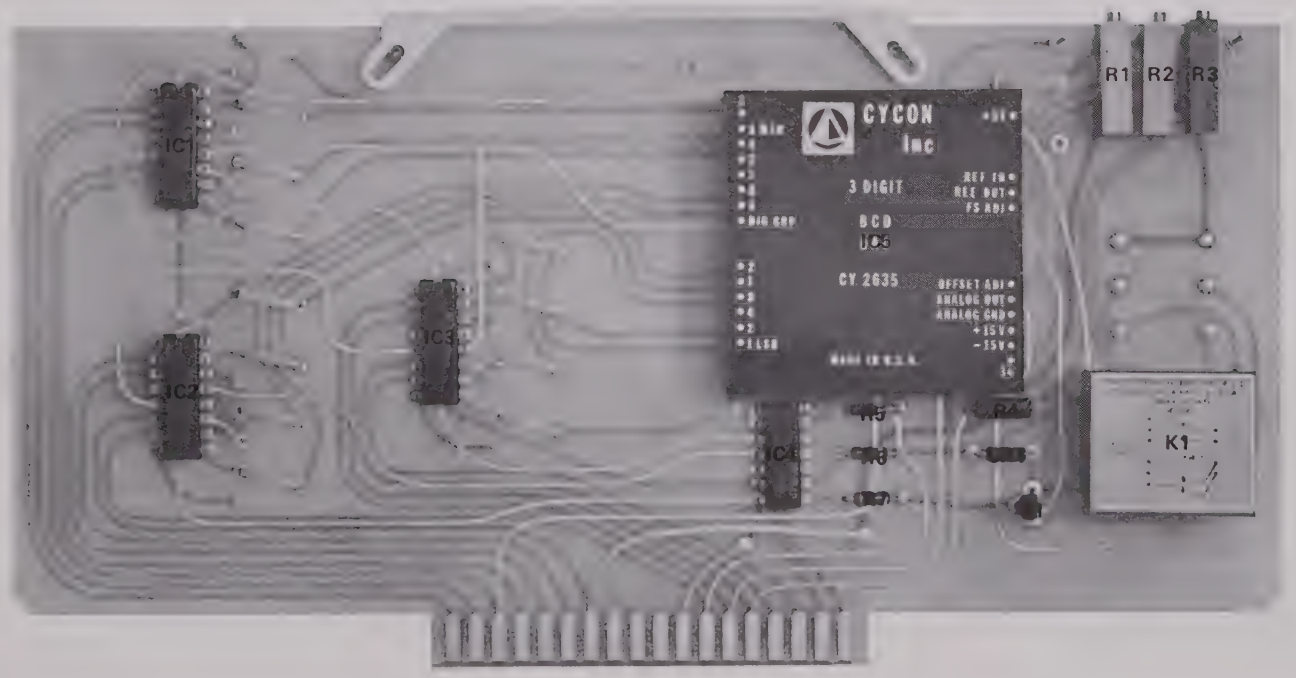


Figure 6-9. Assembly A3, Remote Programming Component Identification.

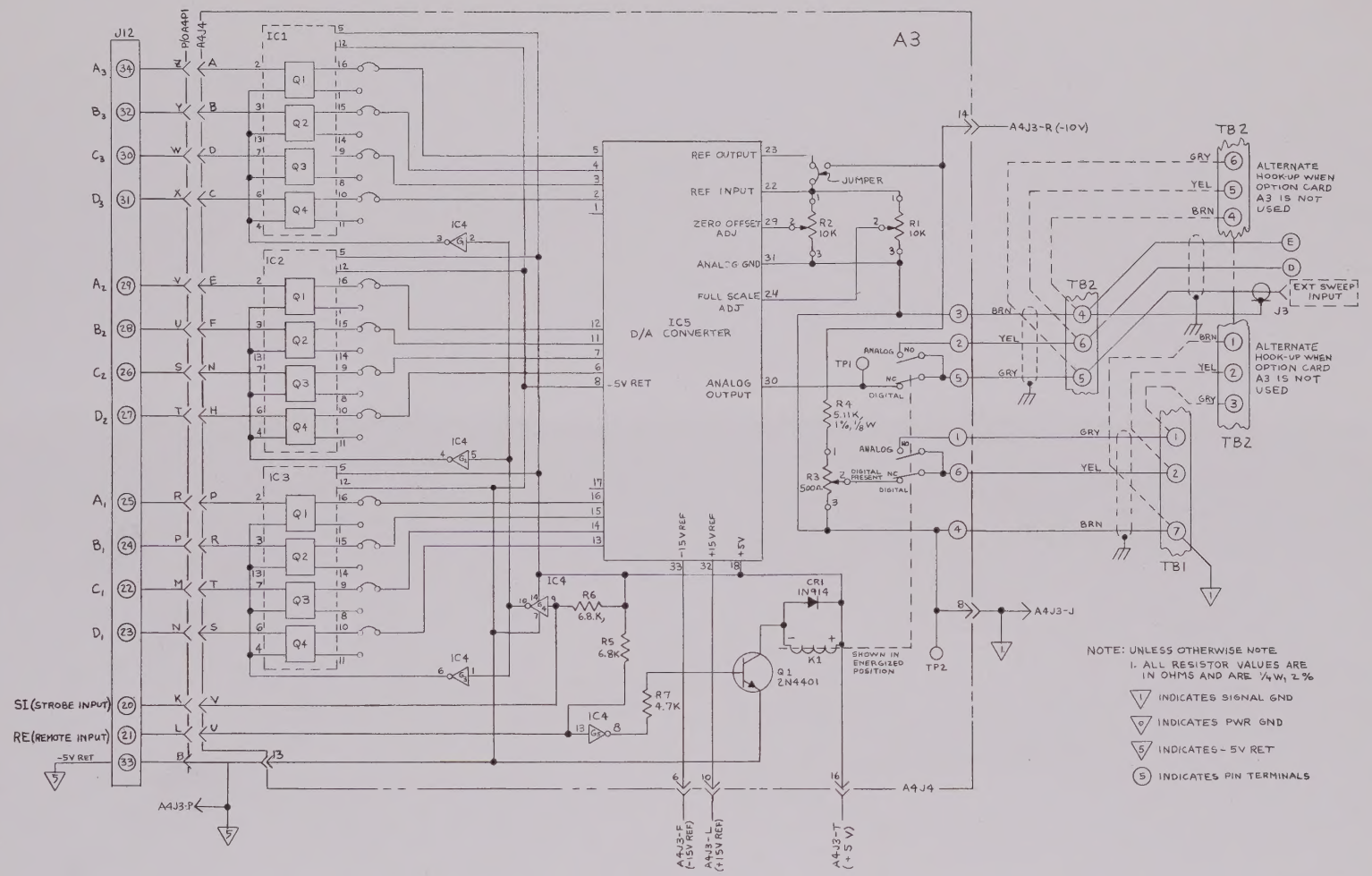


Figure 6-10. Assembly A3, Remote Programming Schematic Diagram.

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